FOOD TECHNOLOGY

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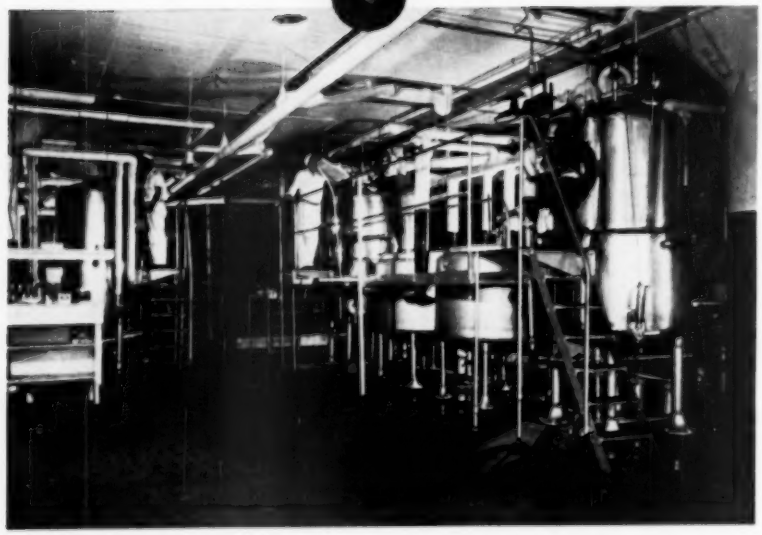

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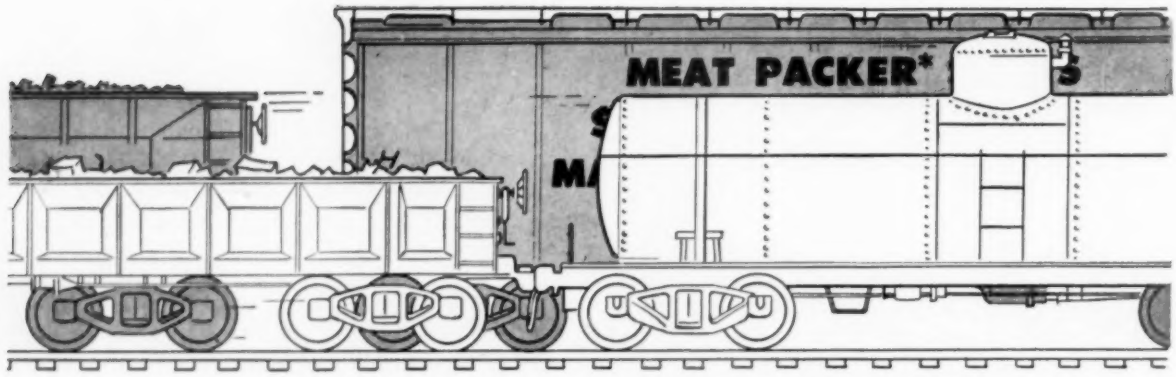

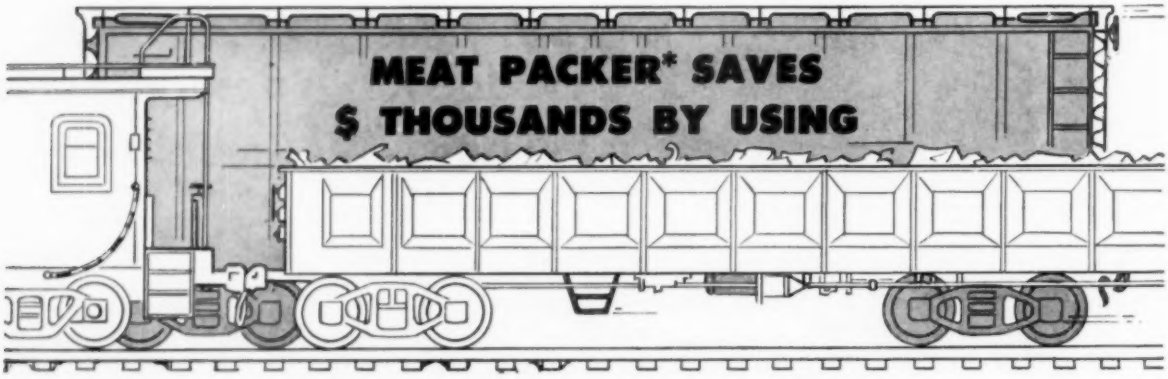

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The Twelfth Appert Award Address

The two papers that follow bring back to mind two memorable occasions—the presentation of the Nicholas Appert Medal to Mr. Victor Conquest, vice-president, Research Division, Armour and Co. at the Appert banquet and the notable address of the recipient of that award to the throng that gathered to hear him in the Assembly Room of the Statler in Boston on Wednesday, June 24, 1953. The Appert Award takes on increased stature each year—as is evidenced by the wide attention given it in the technical journals and in other departments of the press. The reason for this is easily found—the calibre of the men honored. Of no lesser merit are the thoughts expressed in the series of addresses by the award winners, of which series Mr. Conquest's speech is the twelfth.

PRESENTATION OF THE NICHOLAS APPERT AWARD FOR 1953

George E. Brissey, Chicago Section, IFT

In making the twelfth annual presentation of the Nicholas Appert Medal Award, we are honoring a man who "because of his preeminence in and contribution to the field of food technology, is deemed worthy of special recognition." In addition, however, we recall with satisfaction the distinguished food technologists who were the prior medalists; and, of course, the man after whom the award is named since his work in the field of food technology approximately 150 years ago started the development of today's vast canning industry.

In commemorating the 200th birthday anniversary of Nicholas Appert on October 23, 1952, much was written and spoken about the importance of his contributions. He has been called the "Father of Canning" and had the title "Benefactor of Humanity" bestowed by the French Society for the Encouragement of National Industry.

In accepting an illuminated scroll presented in 1952 by the National Canners Association to transmit to the Mayor of Massy, a town near Paris where Appert lived and conducted most of his work, M. de Juniac, Minister Plenipotentiary of the Embassy of France in the U. S., stated, "It is difficult to know how much one is indebted to the inventor of the process, and how much one owes to those who applied his invention, who perfected it, and who gave it the quality and development it has reached today."

From its very humble start where Appert used stout glass bottles stoppered with cork as containers for his heat preserved foods, the canning industry has made tremendous strides. In the United States alone it comprises about 3,500 canneries in 47 states and all the territories which annually produce some 400 different canned food items: fruit, vegetables, juices, fish and sea foods, meat, soups, baby foods, milk, preserves and many formulated foods. Each year this production amounts to approximately 20 billion pounds, representing about six percent of the nation's food supply and having a value of 2½ billions of dollars.

The first commercial canning was started in the United States in 1819—in Boston by William Underwood and in New York by Thomas Kensett and Ezra Daggett. Developments and expansion were slow though continuing. The invention of the retort about 75 years ago by A. K. Shriver of Baltimore contributed measurably to the growth of the industry. The number of establishments increased from less than 100 in 1870 to 1800 thirty years later. The invention of the so-called sanitary can about 1900 was another important technological development that did much to expand canned foods production.

Official estimates of the U. S. Department of Agriculture show the average per capita consumption of all types of canned foods to be approximately 100 pounds per year exclusive of baby foods. It has been estimated that children under 3 consume about 60 pounds of canned baby foods annually.

To produce this amount of canned foods, the canners provide direct employment for about 500,000 persons. The many related industries—suppliers, distributors, transportation companies, and retail establishments such as the seed industry, can and glass container manufacturers, producers of a wide variety of cannnig machinery, label manufacturers, suppliers of seasoning such as sugar and salt, carton and shipping container producers, shipping companies, the wholesale grocery trade, food chains, and food brokers—multiply the persons involved many-fold.

Though Appert was scientific in his approach, he was without the benefit of the sciences since bacteriology was unknown and chemistry just emerging from the days of the alchemist. It was not until many years later that Louis Pasteur demonstrated that micro-organisms which cause food spoilage were destroyed by heat. Pasteur properly credits Appert for his discovery. In spite of the limitations imposed by the lack of scientific assistance, Appert continued in the expansion of his discovery. From the publication in 1810 of his "Art of Preserving All Kinds of Animal and Vegetable Substances" which set forth the procedures used in canning more than 50 different foods, until his death in 1841 at the age of 89, he broadened the application of his methods, enlarged the physical scope of his production, and stimulated many others to follow in his footsteps.

It was not until near the turn of the present century that we see the first real application of science to the art of canning. At this time began the pioneer studies of H. L. Russell in Wisconsin, those of our dearly beloved Samuel C. Prescott, and of W. Lyman Underwood of Massachusetts. Their demonstrations of the application of the science of bacteriology to the canning of foods opened vast new fields in the use of scientific methods. The twentieth century has witnessed a continuation of

(Continued on page 6)

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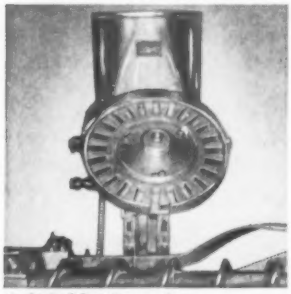

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canning industry expansion. Since the days of the crude experiments by Appert and others nearly 150 years ago, canning has been brought to such a high point of efficiency, through the restless genius of American inventors, scientists and businessmen, that civilized progress could not exist without it. Canning has made possible the wonders of scientific explorations, of colonization; it has proven a priceless boon to the housewife; it has furnished profitable outlets for the products of the farm, the orchard, and the mysterious sea; it has reduced food costs for the average family, and has placed choice, nutritious, and wholesome foods within the reach of millions, producing for America, in particular, the highest of living standards.

Since Appert, there has been a parade of outstanding personalities — ceaselessly devoting their efforts, and their lives, to the improvement of mankind through the application of science to food. This profound devotion reminds one of the wondrous words of Melville's dedication to the Pacific in his memorable novel, *Moby Dick:* "There is, one knows not what sweet mystery about this sea, whose gently awful stirrings seem to speak of some soul beneath; like those fabled undulations of the Ephesian sod over the buried Evangelist St. John. And meet it is, that over these sea-pastures, wide-rolling watery prairies and Potters' Fields of all four continents, the waves should rise and fall, and ebb and flow unceasingly; for here, millions of mixed shades and shadows, drowned dreams, somnambulisms, reveries; all that we call lives and souls, lie dreaming, dreaming still; tossing like slumberers in their beds; the ever rolling waves but made so by their restlessness.

"To any meditative Magian rover, this serene Pacific, once beheld, must ever after be the sea of his adoption. It rolls the midmost waters of the world, the Indian Ocean and Atlantic being but its arms. The same waves wash the moles of the new-built California towns, but yesterday planted by the recentest race of men, and lave the faded but still gorgeous skirts of Asiatic lands, older than Abraham; while all between float milky-ways of coral isles, and low-lying, endless, unknown archipelagoes, and impenetrable Japans. Thus, this mysterious, divine Pacific zones the world's whole bulk about; makes all coasts one bay to it; seems the tide-beating heart of earth. Lifted by those eternal swells, you needs must own the seductive god, bowing your head to Pan."

True to the traditions of him who inspired the medal and to the prior medalists, Victor Conquest has pursued a life dedicated to the science of food and has stimulated hundreds of others in the same course. The "sea of his adoption" has been science. It is with extreme pleasure that, on behalf of the Chicago Section, I present to you, Vic, the Nicholas Appert Medal Award for 1953.

A CHALLENGE TO THE FOOD TECHNOLOGIST

Victor Conquest

From the earliest recorded history, we read of the many challenges that have faced man. The stone age man, with his undeveloped intellect and few weapons, faced the challenge of mere survival. As man progressed, he successfully met every challenge, only to find each age presenting many new ones.

Today—in the age of technology—many problems stand as a challenge to modern ingenuity. I ask: What is today's challenge to food technology and the food technologist? What can and must be done to successfully meet that challenge?

The challenge, as I see it, lies in the food technologist doing his part in solving the problems involved in the increasing need for larger amounts of more nutritious food for our own and the world's ever-growing population. That statement is not intended to be a pessimistic or scare statement. We can calmly examine the facts and see what must be done to insure a continuation of our national level of nutrition and to improve it as we know is possible.

Although I direct this challenge to the food technologist because of his training and ability, I should like to point out that the solution to this problem does not rest solely on his shoulders. Rather, it is a broad responsibility of many people and many groups, wherein each must recognize his responsibilities within his own area of competence, and contribute to the solution.

The food technologist, along with his associates, has a very definite part to play in increasing and improving our future food supply. He must assume the major responsibility in the problem, and by his effort and example encourage others to do their part. The food technologist's work must be planned and coordinated with all other agencies dedicated to the same end result.

Looking back upon the accomplishments of American agriculture and food industry since the Declaration of Independence shows that we have made remarkable progress. Our people are fed better than any other nation of the world, and we traditionally have had a surplus of food for the less fortunate or less progressive world population.

Food technologists, before and since the time of Nicholas Appert, have contributed greatly to our progress in producing and utilizing foods. Through research and investigation we have improved our food production and technology of foods, and have laid by a store of useful and valuable information which will solve some of the food and nutrition problems of the future. For many reasons—good or bad—we are not now utilizing our full available knowledge. The best recent presentation of this condition has been made by B. T. Shaw of the Department of Agriculture. Possibly we are so well provided for that we do not yet have to call upon the newer knowledge. Perhaps, too, many of us resist change until an emergency makes a change vital to survival. There seems to be general agreement that more research in agriculture and food is needed, even though we are not now making use of the results good research in the past has achieved.

Hindsight tells us, however, that we have made mistakes in managing food problems. It is hoped that recognition of these past mistakes, along with clear thinking, will help us avoid any serious future mistakes.

A general feeling exists that errors are currently being made in certain procedures involving food pro-

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duction, storage, and distribution. Good judgment can be expected to correct any serious deficiencies once the facts are known.

We know our agriculture is expanding, but the question is, is it expanding enough, and fast enough, to help us avoid serious shortages in food and feed 50 or 100 years hence? Here are some of the trends:

While our population has increased about 70 millions since 1900—a steep curve when plotted—our present rate of growth (stated as 7,000 per day) indicates, now, a much steeper slope to the growth curve.

Since 1900 the farm population has decreased about a million, indicating our urbanization as well as the increased farm efficiency from newer knowledge and mechanization.

Tractors and trucks on farms, too few to count in 1910, now number nearly 7 million. American manufacturers of farm machinery have done a remarkable job in lightening farm work.

Land devoted to farming has increased only about 300 million acres in fifty years, again showing our proficiency in food production, which up to the present time has been ample for our growing population with additional huge quantities available for export. That we still have a tremendous potential for future production is evident.

From harvest to the consumer there is an average loss of product amounting to 20 per cent. Some is lost on the farm, some in transport and storage, some in processing, and some by wasteful food handling at the consumer level. This loss to our economy is inexcusable, even though we have come to accept it.

In the areas mentioned above, the food technologist can continue to make good contributions in the future as he has in the past.

The presently unanswerable question is, how long will our natural resources of good top soil and water hold out? We know there is an end to new arable land; an end to top soil that washes to the oceans by cubic miles each year; an end to fertility if not considered and replaced. We do not know enough of the pertinent factors to be able to feed data to an electronic brain and receive and answer as to what to do about food supplies, and when and how to do it. We do, however, possess powers of reasoning, and until better mathematical factors are found must depend upon our common sense to recognize the problems and take early action to work out the answers.

Many of the good things we are doing to extend our food production should be continued.

We must not only continue our program of soil, forest, and water conservation, but must do it better with more scientific control and less political and emotional domination.

We need to learn how to save soil and water at their source, not after they have started down the rivers. To many trying to solve the problem this means a combination of maintaining suitable vegetation with innumerable small water flow-retarding ponds, lakes and dams high in the back country. To others it means huge dams far down stream, which can be combined into a power project for farm or industry. Perhaps with a little good planning, both types of operation would be possible.

We must encourage and cooperate with our plant geneticists and crop experts to help them improve their results. We look to these experts to develop more pest- and climate-resisting crops; to grow food crops that yield more and better nutrition; and to recommend best farming methods and conditions.

We must do all we can to encourage the utilization of existing knowledge in food production, both at the farm level and by the food technologist. The long lag between proven developments and their general acceptance is a problem calling for a better solution.

We need to continue our good work in the fields of pest control agents and plant foods of improved utility. Along with the chemical aspects of farming and food processing, we should be alert so as to avoid the use of undesirable and harmful practices and agents.

We need the continued development of farm machines, so that more production with less exertion can be had.

We need to do an increasingly good job in storing and processing our foods, so that maximum quality and nutrition are retained.

The food technologist can draw upon his specialized training and the sciences at his command to do many things for the food industry.

The food technologist, in cooperation with other scientists, must remember that he is not only responsible for the quantity and variety of our foods, but that he also has the responsibility to produce foods that are of the very best in nutritive characteristics.

The terms "food" and "nutrition" are not synonymous. Products which may be delightful to the palate may be very inadequate nutritionally. It is certainly necessary that the food technologist think in terms of nutrition as well as in terms of food.

Besides the standard operations of improving products and processes, the food technologist must give increasing attention to the subject of waste control.

Waste control starts, of course, by recovering all possible food product from the harvested material and delivering it to a processing plant and consumer. After that the natural wastes need to be turned into their highest value products. In most food processing plants, and in meat packing especially, better utilization of by-products and wastes is a continuing and urgent necessity. Over the years, credits from by-product utilization have brought greater returns to the livestock producer and have helped maintain moderate meat prices.

Reduction of wastes and waste waters from food processing plants is not only useful, but avoids a nuisance to the community. Today we all recognize our responsibilities in regard to good public relations for the food industry.

The points I have made are only a partial list of the jobs to be done and the problems to be solved. It is not necessary for me to note in detail just where the food

(Continued on page 10)

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WORLD'S LARGEST SUPPLIERS OF VANILLIN

THE TWELFTH APPERT AWARD ADDRESS

(Continued from page 8)

technologist can and does fit into this program. He can see and accept his part of the responsibility for insuring our food supply of the future.

The consumer, as well as the food industry, must be made to realize the fact that future food security depends upon adequate research and investigation. We need to add to our research efforts in all areas from soil to table. The food and allied industries are doing a good job on today's problems.

There is more, and a bigger job to be done. The food technologist can and will recognize his responsibilities and aid in a solution of the common problem—more and better nutrition from our agricultural industry.

Resolution of Appreciation for Work of Northeast Section, Boston Annual Meeting Host

In formal session, the Council of the Institute of Food Technologists, by unanimous action, directed the Resolutions Committee to prepare and to present the following resolution to the membership. As Chairman of this Committee, it is my pleasure to present this resolution at this time.

WHEREAS, the membership of the Northeast Section individually and collectively, with infinite care and great effort, has contributed its efforts, its talents, and material goods to arrange for and to conduct our 13th Annual Meeting.

WHEREAS, the membership of the Institute is desirous of recognizing the valuable contributions of these many persons and organizations, and

WHEREAS, it seems particularly appropriate to recognize with emphasis these contributions since this is the birthplace of our Institute; now therefore, be it

RESOLVED, That the Institute of Food Technologists express its sincere appreciation and gratitude for the fine services rendered by the following individuals and organizations:

Anchor Hocking Glass Corp.—Hugh Robinson.

Artisan Metals Products—James Donovan, Craig W. Angell, Mary Norton, Jack Marshall.

Bradbury Research Associates—Jack L. LaPuck.

Julius Brody Co.—Julius Brody.

Cherry Burrell Corp.—W. P. Hinckley.

Colonial Provisions Co., Inc.—I. E. Malkin.

W. L. Cummings & Co.—W. Leverett Cummings.

Developments, Inc.—O. P. Pierson.

Dewey & Almy Chemical Co.—Robert J. Gray, Theodore T. Miller, Richard Parsons, Viola Ray.

Dunwoody Engineering Co.—Archibald B. Dunwoody.

Eastern Nazarene College—James H. Shrader.

First National Stores, Inc.—Ernest R. Barron.

The Foxboro Company—Lyle Richardson.

General Foods Corporation—Edward J. Murphy.

Aberjona Division—Sidney Feener.

Atlantic Gelatin Division—Joseph M. Cohen, J. Avery Dunn, Harry Rosenthal, Mary Tighe.

Walter Baker Division—Norman W. Kempf.

Birds Eye Division—William F. Hampton, Daniel J. Heald, Edward J. Maher, John McLaughlin.

Gorton Pew Fisheries Co., Ltd.—Earl P. McFee, Ruth Stevens Perry, John Kohr, Stanley P. Hurley.

Great Atlantic & Pacific Tea Co.—*National Fish Dept.*—Charles H. Shackelford, John E. Barry, Jr.

Haffenreffer & Co., Inc.—A. H. Haffenreffer, Jr.

H. P. Hood & Sons—Arthur C. Fay, Charles C. Walts.

Rodney Hunt Machine Co.—Arne R. Gudheim, Calvin L. Rasmussen.

H. A. Johnson Company—Henri S. Lench.

Howard Johnson Company—M. P. McArdle.

Lincoln Foods, Inc.—Daniel Issenberg.

Arthur D. Little, Inc.—Verne M. Bass, Warren Berg, Jean F. Caul, Ernest C. Crocker, Marguerite DeFren, Pamela Low, John H. Moriarty, Anne J. Neilson, Helen Noren, Ruth M. Power, Loren B. Sjostrom, Robert L. Swaine.

Maine Agricultural Experiment Station—Matthew E. Highlands.

Massachusetts Institute of Technology—Yaichi Aikowa, Cecil G. Dunn, Samuel A. Goldblith, David Lang, Ernest E. Lockhart, William C. Miller, Jr., J. T. R. Nickerson, Lynn Oberle, Capt. Ruben Pomerentz, Samuel C. Prescott, Bernard E. Proctor, Joseph Stern, Elsie Wilson.

Dorothy Muriel's—John M. Milne.

New England Confectionery Co.—Ernest C. Peakes.

Northeastern University—Blanche Dailey.

Proctor & Gamble Co.—Clifford J. Robertson.

Revere Sugar Refinery—J. M. Brown.

Seaplant Chemical Co.—Leonard Stoloff.

Standard Laboratories—Cyril C. Sullivan.

John P. Squire Co.—John F. Thompson.

W. F. Skilling Co.—W. Frank Skilling.

Wm. Underwood Co.—L. E. Wyman, Raymond M. Swaine.

United Fruit Company—Leo G. Cox, Mrs. V. K. Watson.

University of Massachusetts—Edward E. Anderson, William B. Esselen, Jr., Carl R. Fellers, Harold Gorfien, Kirby M. Hayes, Arthur S. Levine, Laurent Ouellet, Irving J. Pflug, Arnold Roseman, Zakaria Sabry, Paul Smith.

U. S. Air Force—Norman Glaskin.

U. S. Fish & Wildlife Service—Joseph F. Puncochar, John Holston.

U. S. Food & Drug Administration—F. Leslie Hart, Mary C. Harrigan.

U. S. Testing Company—Burton G. Philbrick.

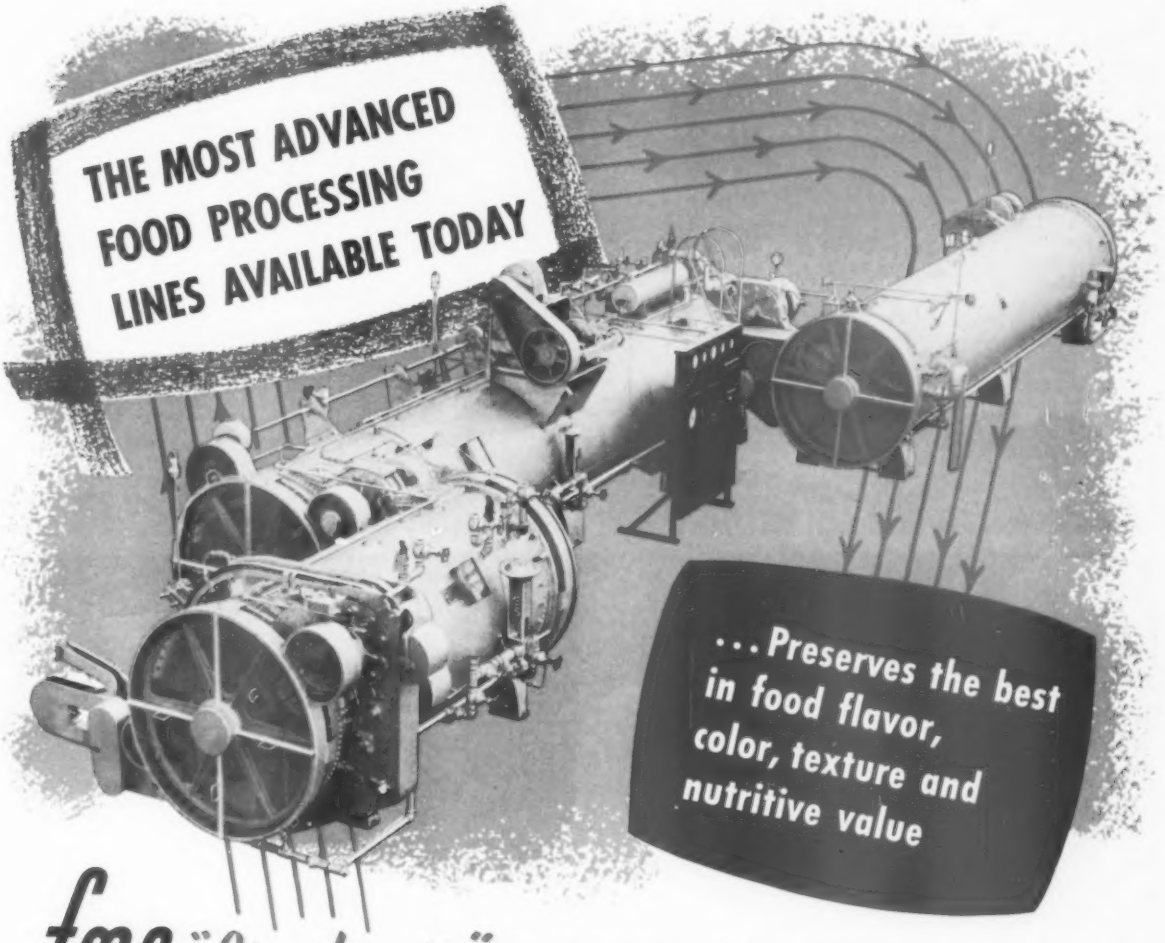
L. A. Whitney Co., Inc.—A. William Whitney.

J. D. Whitten Co., Inc.—William I. Gorfinkle.

Wilbur-Suchard Chocolate Co.—Arthur E. Welch.

Respectfully submitted,
ARTHUR N. PRATER
Chairman, Resolutions Committee

Resolution adopted by unanimous vote of members present.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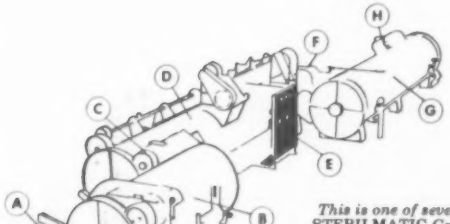

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High-speed *STERILMATIC* Cooker and Cooler lines give canners the *precise processing control* needed to maintain their high standard of product quality and uniformity. This continuous, automatic equipment cooks every can *evenly*—cooks every can *exactly alike.* The natural flavor, color, texture and essential vitamins of farm-fresh fruits and vegetables are protected and preserved at their peak of harvest perfection. And these qualities last, too—locked in to be fully enjoyed when the can is opened and the product served. Write for full information on FMC's outstanding "one-man cook room," or call your nearest FMC representative.

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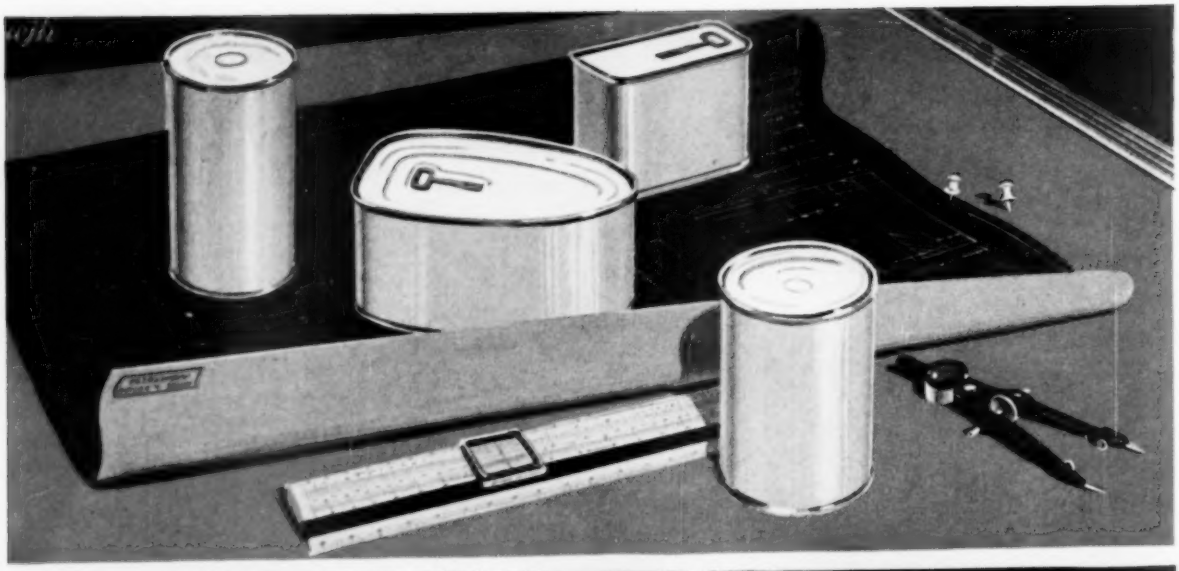

CANADA
United States
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27 28 29 30

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← Where you want it...

← and when!

Take the simple word, "Ability." When a supplier has that—*plus* enterprise and foresight—it becomes an even more important word: "Availability."

Time after time, since the turn of the century, manufacturers have come to Canco wanting new and different types of packages for new and different types of products. Time after time . . . we've been *ready* with the answer.

For Canco doesn't wait to be asked. We are constantly striving to improve the methods and materials we use to help customers and prospective customers market their products more profitably.

In short, no other organization can match Canco's *combination* of people, conveniently located plants, research, technical assistance, delivery service, quality and experience. As a result, you get *what* you want . . . *where* you want it, and *when!*

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Through the years, constant Canco pioneering and cooperation with the canning industry have brought forth widespread process and product improvement—opening new markets for canned foods of all kinds.

Annual Meeting Bulletin Board

IT'S LOS ANGELES IN '54 — JUNE 27 THROUGH JULY 1

The current status of the Los Angeles program, along with certain other pertinent information, has just been released by Dr. Arthur N. Prater, Program Chairman.

Papers. Three copies of the abstract of a proposed paper, together with the correct name, affiliation and address of the authors and the correct title of the paper, are requested to be in the hands of the various *symposia chairmen or general sessions chairman* no later than February 1, 1954.

Abstracts. The abstracts should be carefully prepared, should be brief and yet be informative. They should be written with the title, author, affiliation, address and the type of general context indicated in the abstracts which appeared in the May, 1953, issue of FOOD TECHNOLOGY. Three copies of each abstract are required by the appropriate symposia chairmen or for general papers by the General Program Chairman, Dr. Arthur N. Prater, Gentry Division, Consolidated Grocers Corporation, 837 North Spring Street, Los Angeles, California. Deadline: 1 February 1954.

There will be from 2½ to 3 hours available for the morning and afternoon sessions. It is planned to insert a 5-minute break in the middle of each session, to allow the audience to stretch and relax. Every effort will be made to hold all meetings according to an exact time schedule, and 20 minutes will be the time allotted for both the paper and the discussion period. If, as in the case of certain symposia, it is strictly necessary, longer papers may be scheduled.

The committee has hit upon a scheme to prevent cruelty to audiences. The presiding officers will be provided with laboratory timers or other noise-making devices, and, after a brief but polite warning period, any speaker who persists in grossly over-extending his time period will have mechanical competition. In fairness to the audience, the committee feels, it is essential that meetings be held as nearly to schedule as possible. In general, the symposia will be one-half day in length, although, in some cases, one full day will be allowed. No papers will be accepted after the deadline date (1 February 1954) and no symposia paper will be scheduled if the complete symposia details are not received by the symposia chairmen by the deadline date announced. These dates are essential to the preparation and printing of the final program and only confusion and hardship can result if these dates are not adhered to. Since this program is being arranged well in advance and these deadline dates are being publicized at this time, there should be no difficulty in having the abstracts and the information ready in time.

The following program is to be considered final in so far as the symposia leaders are concerned, although additional symposia topics may be added if the demand justifies. Communications concerning symposia should be handled directly with the responsible leader. *Symposia leaders have the right to accept or reject any papers voluntarily submitted.* Papers submitted for the general sessions which may fit into the subject matter of the symposia will be offered to the various symposia leaders. Any papers which are submitted which do not fit into the symposia will be considered for general sessions.

THE 1954 PROGRAM

Here is the program, as presently established, together with the leaders of the symposia and their addresses:

Problems in Fruit and Vegetable Research and Technology

PROFESSOR JOHN H. MAC GILLIVRAY, Department of Vegetable Crops, University of California, Davis, California

Flavor Changes in Foods as Influenced by Applied Chemicals

DR. CHARLES H. MAHONEY, National Canners Association, 1133 Twentieth Street, N. W., Washington 6, D. C.

Food and Drug Standards

MR. CHARLES W. KAUFMAN, Kraft Foods Company, 500 Peshtigo Court, Chicago 90, Illinois.

Citrus Concentrates

DR. W. R. ROY, Minute Maid Corporation, Plymouth, Florida.

Recent Basic Investigations in Food Science

DR. AKSEL G. OLSEN, General Foods Corporation, Central Laboratories, 11th and Hudson Streets, Hoboken, New Jersey.

Consumer Testing

DR. HELEN L. HANSON, Western Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, Albany 6, California.

Marketing Problems

MR. ROY H. WALTERS, General Foods Corporation, 250 Park Avenue, New York 17, New York.

Special Purpose Foods

DR. ERNEST GEIGER, 3842 Monteith Drive, Los Angeles 43, California.

Seafood and Seafood Products

MR. KARL ENVOLDSEN, Envoldsen Shrimp, Inc., 1200 West Ninth Street, Cleveland 13, Ohio.

Wine and Wine-tasting

MR. HAROLD W. BERG, Department of Viticulture, University of California, Davis, California.

Food Engineering

DR. CURTIS E. MAIER, Continental Can Company, Inc., 4645 West Grand Avenue, Chicago 39, Illinois.

What's New In Food Packaging

DR. KENNETH W. BRIGHTON, American Can Company, Inc., 11th Avenue and St. Charles Road, Maywood, Illinois.

Pectin and Pectic Materials in Relation to Food Processing and Preservation

DR. REESE H. VAUGHN, Department of Food Technology, University of California, Davis, California.

(Continued on page 16)

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ANNUAL MEETING BULLETIN BOARD

(Continued from page 14)

Roundtable Discussions

DR. M. L. ANSON, Lever Brothers Research Center, Edgewater, New Jersey.

At the 1954 meeting the IFT will try the experiment of providing meeting rooms for small informal discussion groups. Each group will have a leader who will invite the participants and guide the discussion. The discussion gatherings will be outside of the formal program, in that many of these will be restricted to those who have indicated an interest in participating and who are invited prior to the meeting.

Dr. Anson has been assigned the responsibility of choosing a small number of subjects and leaders for this 1954 experiment and for scheduling a time and a place for each discussion gathering and of reporting on the results of the experiment to the IFT. Members of the Institute who desire to have provision made for such small discussion groups are requested to make their wishes known to Dr. Anson. These discussion periods are not intended to provide for the meeting of regularly established committees of the Institute. Provisions will be made elsewhere in the program for these committees to meet if such a meeting is requested.

General Papers

DR. ARTHUR N. PRATER, Gentry Division, Consolidated Grocers Corporation, 837 North Spring Street, Los Angeles 12, California.

Frozen Foods. At the request of the Committee on Frozen Foods, there will be a session on frozen foods and an informal open discussion meeting of the Committee. In charge will be the Chairman of this committee: DR. K. G. DYKSTRA, Birds Eye Division, General Foods Corporation, 162 South Main Street, Albion, New York.

There are various other committees of the Institute which may desire a time and place for a meeting in Los Angeles. If these committees will make their wishes known promptly to the General Program Chairman, a space and a time will be allotted for such a meeting. In so far as possible, please designate the size of room desired, and if any time preference exists, please so indicate. It would be helpful if this information were received as soon as possible, and, in any event, *no later than February 1, 1954.*

Every effort will be made to adhere to the scheduling and arranging of the papers and symposia as requested by the individual authors and by the symposia leaders. The final program as printed in FOOD TECHNOLOGY however, will constitute the official notification of the exact timing, as it may become necessary to rearrange time schedules in the interest of the entire program.

Dr. Samuel A. Goldblith, M.I.T., Wins 1953 Monsanto Award

Dr. C. Olin Ball, Monsanto Presentation Award Chairman, has announced the winner of the 1953 contest to be Dr. S. A. Goldblith, associate professor of food technology at Massachusetts Institute of Technology. "Relative Bactericidal Efficiencies of Three Types of High-Energy Ionizing Irradiations," was the subject of the winning paper. It was distinguished by effective organization, clarity and accuracy of content, and, on the verbal side, by excellent delivery. As previously, the winner was selected after extensive evaluation by a corps of judges who covered, among them, all the papers of all the sessions, rating all speakers in each session numerically. From the leading contenders the winning paper was selected by ballot.

Dr. Goldblith received his training at M. I. T. and holds three degrees from this institution. After attaining his doctorate in 1949 he joined the staff of M. I. T. as a research associate. In 1952 he was appointed assistant professor of food technology. His field of research is radiation and the sterilization of foods by this comparatively new experimental method.

During World War II Dr. Goldblith was with the U. S. Army in the Philippines.

The Monsanto Presentation Award is based on the concept that the papers presented at annual meetings of scientific societies should be well organized and effectively delivered. With the purpose of calling attention to papers painstakingly prepared and competently projected to the audience, verbally and visually, the award, which carries with it an honorarium, was established by the Monsanto company in 1952.

Regional Section News

TEXAS SECTION

The Texas Section at their Houston meeting last spring elected the following slate of officers for the ensuing year:

Chairman: Dr. A. V. Moore, Professor in Dairy Manufactures, Texas A & M College.

Vice Chairman: Mr. Ernest Grohman, General Foods (Maxwell House).

Sec.-Treas.: Dr. Isaac Peters, Assoc. Professor in Dairy Manufactures, Texas A & M College.

Director and Councilor: Mr. B. L. Golub, President, Belle Products Company, Houston, Texas.

It was decided at the above meeting to narrow the radius of this section somewhat by having the majority of meetings in Houston.

Two additional meetings have been held since with fair to good attendance, namely: (1) May 13 at Bill Williams Restaurant, Houston (42 persons attending), topic of the Speaker: "General Food Plant Sanitation" by Mr. J. P. Greze, Bacteriologist for Oakite Products Company; (2) July 23 on boat of Port of Houston (21 persons attending). Nature of meeting: excursion along

the Houston Ship channel combined with a report on the National IFT meeting by Dr. Joseph H. Gast, Baylor University.

The next meeting is planned for September 26 on the campus of Texas A & M College at College Station. Plans are to have technical reports in the afternoon and for the sports fans a football game in the evening.

PITTSBURGH SECTION

The following is a summary of the activities of the Pittsburgh Section of the Institute of Food Technologists. Five meetings were held—three of which were dinner meetings; one field trip to the Weirton Steel Company and Advance Metal Lithographing Company, Inc., Weirton, W. Va.; and one-half day Symposium with six papers followed by dinner and the annual meeting.

On December 16, 1952, Mr. V. W. Vaurio of the U. S. Steel Company's Research Laboratory gave a paper on "Corrosion of Lacquered Tin Plate: Influence of Type of Steel and Weight of Tin Coating on Performances of Jar Can Closures."

On February 10, 1953, Mr. C. E. Maier, Manager of Research of the Continental Can Company, gave a very interesting talk on "Trends of Interest to the Canner." Mr. Maier's discussion included a historical review, present developments and future trends of both container manufacturing and processing methods. His talk was followed by a short movie on can manufacture.

On March 10, 1953, Dr. Edmund H. Hammann, Chief Chemist of the Flavor Division of Fritzsche Brothers, Inc. addressed the group on "Flavor."

On the afternoon of April 14, 1953, the Section visited the Weirton Steel Company's Tin Mill and Advance Metal Lithographing Company, Inc. After the tour of the factories, the Section assembled at the Williams Country Club for dinner. Mr. J. A. Jones of the Weirton Steel Company showed a movie with his commentary on "The Labrador Ore Project."

On the afternoon of May 12, 1953, the Pittsburgh Section held a Symposium with the following papers:

"Safety Beyond Reasonable Doubt." H. F. Smythe, Jr., Administrative Fellow, Mellon Institute.

"Recent Studies in the Genetics and Breeding of Tomatoes." R. E. Larson, Head of the Department of Horticulture, Pennsylvania State College.

"Relationship of Bacteriological Sub-Culturing Media to Thermal Process Evaluation." J. L. Secrist, H. J. Heinz Company.

"Palatability Panels in Judging Food Quality." Mary L. Dodds, Professor, and Grace Bennett, Assistant Professor, Food and Nutrition, Pennsylvania State College.

"The Role of Yeast Endoproteases in the Ripening of Soft Cheeses." J. F. Cone, Professor of Bacteriology, Pennsylvania State College.

"Nutrition in Relation to Dental Caries." G. L. Cox, Director of Dental Research, University of Pittsburgh.

In the evening the Section re-assembled for dinner and the annual business meeting which was followed by an address by Dr. Berton S. Clark, Scientific Director of the American Can Company, and President-Elect of the Institute of Food Technologists. The subject of his address was, "How Research Benefits the Food Industry." At this meeting, the results of the election were announced.

The following members were elected to office for the 1953-54 period:

Chairman: Dr. George W. Seagren, Mellon Institute of Industrial Research, 4400 Fifth Avenue, Pittsburgh 13, Pa.

Vice-Chairman: Mr. V. Walter Vaurio, United States Steel Corp., 234 Atwood Street, Pittsburgh 13, Pa.

Secretary-Treasurer: Mr. Paul Somerville, H. J. Heinz Company, 1062 Progress Street, Pittsburgh 30, Pa.

National Councilor: Mr. Daniel M. Gray, Stoner-Mudge, Inc., 2000 Westhall Street, Pittsburgh 33, Pa.

Executive Committee: Mr. Charles J. Steinicke, Duquesne Brewing Company of Pittsburgh, Pittsburgh 3, Pa. (1953-54); Mr. George M. Shiffler, Stoner-Mudge, Inc., 2000 Westhall Street, Pittsburgh 33, Pa. (1953-54); Dr. Imri J. Hutchings, H. J. Heinz Company, 1062 Progress Street, Pittsburgh 30, Pa. (1953-54); Dr. Harry J. Lipman, Mallet and Company, 5475 Bartlett Street, Pittsburgh 17, Pa. (1953-55); Miss Ruth A. Sparks, Stoner-Mudge, Inc., 2000 Westhall Street, Pittsburgh 33, Pa. (1953-55).

OHIO VALLEY SECTION

An election of officers in the Ohio Valley Section of the Institute of Food Technologists was held at the Spring meeting in Lancaster, Ohio, and the following persons were selected:

Chairman: Dr. A. R. Winter, Ohio State University, Columbus, Ohio.

Vice-Chairman (and Chairman Elect): Mr. George F. Garnatz, Kroger Company, Cincinnati, Ohio.

Secretary-Treasurer: M. Eloise Green, The Ohio State University, Columbus, Ohio.

Executive Committee: Elizabeth McKim, Monsanto Chemical Co., Dayton, Ohio; K. S. Chester, Battelle Institute of Columbus, Ohio.

Councilor: N. H. Volle, Kroger Company, Cincinnati, Ohio

AUSTRALIA NORTHERN SECTION

The Annual Meeting of the Australia Northern Section was held on July 14th in the staff room of the C.S.I.R.O., Homebush. The formal business was preceded by a buffet dinner which was washed down with well known local brews. The election of officers for the Section for the forthcoming year resulted as follows:

Chairman: Mr. J. F. Kefford, Divn. of Food Preservation, C.S.I.R.O.

Vice-Chairman: Mr. A. T. Roche, W. H. Brookhouse Pty. Ltd.

Secretary: Dr. V. M. Lewis, Henry Lewis & Sons Pty. Ltd.

Treasurer: Mr. E. G. Davis, Divn. of Food Preservation, C.S.I.R.O.

Councilor: Dr. J. R. Vickery, Divn. of Food Pres., C.S.I.R.O.

Committee: Mr. S. M. Sykes, N. S. W. Dept. of Agriculture; Mr. G. Miller, Kia Ora Industries Ltd.; Mr. W. W. Hopkins, Henry Jones Ltd.; Mr. H. Govers, Tooheys Standard Brewery Ltd.; Mr. J. Forsyth, Provincial Traders Pty. Ltd.; Dr. F. H. Reuter, N. S. W. University of Technology; Mr. W. S. Beale, Gordon Edgell & Sons Ltd.

The main business of the evening was an address by Dr. F. H. Reuter on "Education in Food Technology." Dr. Reuter, who is Associate Professor of Food Technology at the N. S. W. University of Technology has recently made an extensive study of University courses

(Continued on page 20)

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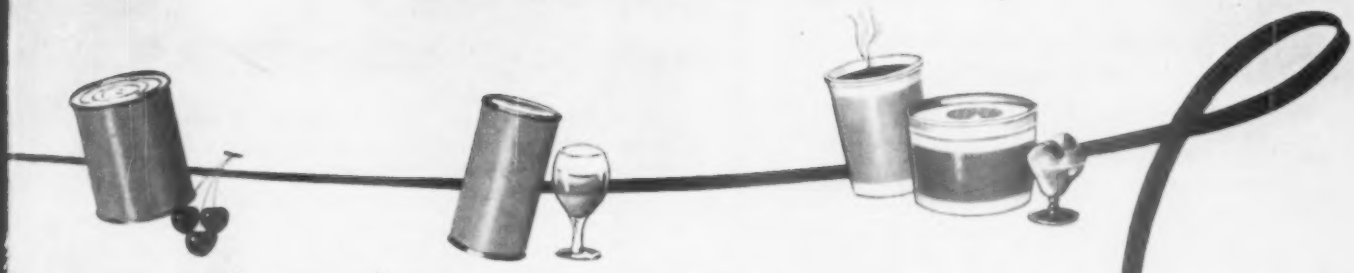

A SUCCESSFUL PRODUCT

IS FUSSY ABOUT ITS "CLOTHES"

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First, the can must fit your product chemically. Some products are quite at home in an unlined can—others require one of Continental's twenty-five special enamel linings.

Next, our "can tailors" carefully consider the way your product is to be used, recommend what would be most convenient for your customers—a plain top, push-on lid, hinged lid, sifter top, pouring spout, handle, or any of a dozen other special features.

We consider, too, the closing and sealing methods and equipment employed in your plant. Whether or not the product develops internal pressure, and how much, how the product will be shipped and stored, whether it will be lithographed. And, of course, the cost of the container must be in line with the proposed selling price of your product.

It may be that your product doesn't belong in a can at all. The right container for it may be one of Continental's paper cups, lightweight fibre drums, bags or a steel drum or pail. But you can be sure that whatever container your product requires, Continental can provide a perfect fit.

If you are planning a new product or improving an existing one, let us take its "measurements" before you decide on a container.

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TIN CANS

FIBRE DRUMS

PAPER CONTAINERS

STEEL PAILS AND DRUMS

CAPS AND CORK

DECOWARE

REGIONAL SECTION NEWS

(Continued from page 17)

in food technology in the U. S. A., Great Britain and France. He discussed the origin of food technology courses, the purpose they served, the general levels of instruction given, and the sources of finance for the courses.

The Australia Northern Section has recently instituted the publication of a bi-monthly newsletter which has been called *Tucker Box*. The name is derived from an Australian expression which describes the food container used by bullock drivers, shearers, drovers and station (ranch) hands in the rural and "outback" areas. Copies of this publication are being mailed regularly to all Regional Section secretaries of the Institute.

FLORIDA SECTION

Newly elected officers of the Florida Section are:

Chairman: Robert W. Kilburn.
Vice-Chairman: Roger Patrick.
Secretary-Treasurer: Donald J. O'Brien, American Can Company, Research Division, P. O. Box 1732, Tampa 1, Florida.
Councilor: Wallace R. Roy.
Executive Committee: James M. Fisk, Vernon C. Praschan.

The Section is looking forward to an active 1953-54 season.

PERSONNEL

GEORGE D. WILSON has been appointed chief of a newly created Division of Food Technology of the American Meat Institute Foundation, H. R. KRAYBILL, director of research and education, announced in July. The Foundation is a research organization affiliated with The University of Chicago.

Dr. Wilson received his bachelor of science degree from Michigan State College and his advanced degrees from the University of Wisconsin. Appointed as a research assistant at Wisconsin in 1949 and as an instructor in 1952, he has engaged in research on the effects of stilbestrol, testosterone and progesterone on lambs and pigs and on the influence of protein levels and aureomycin and vitamin B_{12} supplementation on pork carcass values.

DR. FRANK A. LEE of the New York Agricultural Experiment Station in Geneva is spending six months sabbatical leave at Rutgers University. Dr. Walter A. Maclinn, chairman, Department of Food Technology at Rutgers, reports that Dr. Lee is undertaking two research projects on lipid deterioration in frozen vegetables.

Books

THE FURANS, by A. P. Dunlop and F. N. Peters. 867 pp. A. C. S. Monograph No. 119, published June, 1953, Reinhold Publ. Corp., New York, N. Y., price $18.00.

It is hard to imagine the most seasoned reviewer approaching a task such as this without some feeling of awe. Those who in 1920 authorized the oat hull research could not conceivably have foreseen the outcome. Those who worked on the project must have had tenacity in unusual measure.

Furfural is a chemical intermediate in the manufacture of adiponitrile and hence of nylon. Its use as an intermediate is the largest single outlet of furfural. The solvent applications are numerous, as a selective solvent in the purification of wood rosin, in the refining of petroleum oils, etc. One table shows an estimated charge capacity, for refineries in the U. S., Canada, England, Western Europe and Japan, of more than 100,000 barrels per day. The furfural resins, particularly phenolic-furfural resins, represent a third important outlet.

The book does not include discussion of the condensed ring systems, such as benzofuran, and limitations of space made it necessary to restrict discussions of di- and tetrahydrofurans to instances where they are necessary to understanding the behavior of unsaturated furans.

The monograph abundantly fulfills the hope of the the authors that it should provide a ready source of information on the chemistry (Part I) and uses (Part II) of the furan types, including as it does a comprehensive review of the published work to the end of 1950.

Part II, including the appendix listing furan resin patents, comprises roughly one quarter of the book and should suggest many ideas to the reader for additional applications in the food field, not limited to the refining of vegetable and animal oils, discussed here in some detail.

The food technologist will also be interested in the occurrence of furan types in foods, and in the mechanism of their formation. The work of Wolfrom and of Hurd on degradation of sugars to furfural and hydroxymethylfurfural is rightly selected for discussion. The writer had a slight difficulty in this respect, in tracing 2-hydroxyacetoxyfuran, recently shown to be a sugar degradation product in Cantor's laboratory, indexed thus: KETONES: 2-Furyl, —, hydroxymethyl.

Several unfortunate errors have crept into Table 4, p. 13. While one may properly be grateful for a compilation of existing data, some comment on obvious anomalies would have been helpful. Certainly the solvents employed should have been listed. Values of ϵ from the writer's laboratory are recorded as log ϵ. There are several instances of minima being reported as maxima, e.g., furan, 270 (ref. 56); furfural 240 and hydroxymethylfurfural (HMF) (ref. 56 and 71). The ϵ values for furfuryl alcohol were 0.3 and 0.1 at the maximum and minimum respectively. These should give log ϵ values of —0.52 and —1.0, not —2.48 and —2.0.

In a work of this magnitude, minor errors are inevitable. Spectroscopic data however are particularly useful because they furnish valuable clues as to purity. In the writer's laboratory, the purpose of a survey of these and similar compounds was "to consider under uniform conditions, the extent to which the various compounds tested can contribute to the absorption observed, *ca* 285 mμ, and the conditions under which

they can be detected." Compared with furfural, the absorption constants for furfuryl alcohol and for furan are negligible. It is likely that the observed maxima (*ca* 280) for the alcohol are due to minute traces of the aldehyde or of other impurities. The lowest values are inherently the most probable, in view of the high concentrations needed to record a spectrophotometric reading with any pretension to accuracy. There are also significant unexplained differences in the values for HMF. We feel here, for example, that HMF has still to be adequately characterized, as to physical constants.

It is not to be expected that the enormous mass of data can be analyzed in such detail. The food technologist is necessarily interested in food applications, and of these he will find an abundance. He will also find all relevant literature on the behavior of these compounds in those circumstances where they are involved in undesirable reactions, including the nonenzymatic browning deterioration, though he has no right to expect this to be neatly segregated for his sole convenience. The data are all there, including much on furfural-amino acid interactions.

G. MACKINNEY.

DAIRY ENGINEERING, Second Edition, by A. W. Farrall (Head, Department of Agricultural Engineering, Michigan State College) published by John Wiley & Sons, Inc., New York.

This book, according to Professor Farrall, is prepared for the practical plant operator and for the student of dairy industry. It is a compilation of information concerning the engineering phases of the dairy industry and is presented in a concise, understandable manner.

The first ten chapters of the book contain general engineering information, with the exception of Chapter I. This chapter is on the chemical and physical properties of milk. The titles of these chapters indicate their contents. Simple Mechanical Principles; Power Transmission; Electrical Power and Equipment; Hydraulics and Pumping; Heat Measurement, Transfer and Control; Steam and Its Use in the Dariy Industry; Principles of Refrigeration; Insulation and Cold Storage Rooms; and Heaters—Coolers, Heat-Exchange Equipment, and Milk Storage Tanks. The information contained in these chapters will be of value to all students of food technology who are interested in the engineering asperts of food processing.

The remaining ten chapters deal almost exclusively with equipment, maintenance and design for the dairy industry. Those familiar with the original edition will find the second edition contains new information on continuous butter making equipment, short-time, high-temperature sterilization equipment and additional information on evaporating and drying equipment. Further information is given concerning plant design, new methods of cleaning, and sanitary standards for various types of dairy equipment.

This book is one of the few books published which present a survey of the engineering material applicable to the dairy technology which does not require an extensive engineering background to understand.

JUNIUS M. MCINTIRE.

Selected Abstracts*

ANALYTICAL METHODS

The identification of coumarins and related compounds by filter paper chromatography.

SWAIN, T. *Biochem. J., 53,* 200-8 (1953).

The R_F values on filter-paper chromatograms of a no. of coumarins and related cinnamic acids in various solvents have been detd. The compds. are best detected on the chromatogram by their fluorescence in ultraviolet light. The results obtained with different solvent systems and the color reactions with various spray reagents are discussed in relation to the compds., and suggest that definite indications of structure can be deduced. It is suggested that the coumarins present in natural exts. could be readily sepd. and identified by this method.

A rapid method for estimating pectic substances in citrus juices.

DIETZ, J. H., AND ROUSE, A. H. *Food Research, 18,* 169-77 (1953).

The method utilizes the carbazole-hexuronic acid-sulfuric acid reaction. The pectic substances were divided into 3 groups on the basis of their soly. in water, sodium hexametaphosphate, and NaOH. The procedure is suited to routine control work, with a complete analysis taking 3½ hrs. Results are reported in terms of anhydrogalacturonic acid, the basic structural unit of the pectin molecule.

An improved method of determining concentration of quaternary ammonium compounds in water solutions and in milk.

FURLONG, T. E., AND ELLIKER, P. R. *J. Dairy Sci., 36,* 225-34 (1953).

The method involves titration with standard anionic surface active agent using eosin as indicator. The water method is a direct titration of the sample, whereas the milk method includes an addnl. step involving extn. of the QAC from the milk. The methods cover a sample concn. range of 1 to 100 p.p.m. QAC. The sensitivity of the methods may be increased by increasing the sample size, and a modification of the method for QAC in water soln. is presented that permits a five fold increase in sensitivity.

Alizarin blue as a selective reagent for traces of copper.

FEIGL, F., AND CALDAS, A. *Anal. Chim. Acta, 8,* 117-21 (1953).

A new test for Cu has been developed based on the formation of a blue acid-resistant innercomplex salt of Cu with the dye alizarin blue. The test is more sensitive than all other Cu tests hitherto employed, including tests based on the catalytic action of Cu ions. When carried out as a spot reaction, a limit of identification of 0.0025 γ copper is attained. Procedures are described to detect Cu in water (up to 1 : 10^6) and in Ni salts (up to 0.000025%).

Differential titration of amines.

FRITZ, J. S. *Anal. Chem., 25,* 407-10 (1953).

The theory of differential titrations is discussed and simple potentiometric and indicator methods for differential titrations in nonaq. solvents are proposed. These methods permit analysis of aromatic-aliphatic amine mixts. and certain other mixts. such as aniline-*o*-chloroaniline, pyridine-caffeine, and aniline-sulfathiazole. Preliminary treatment with salicylaldehyde permits the dctn. of both primary and secondary aliphatic amines by a single titration.

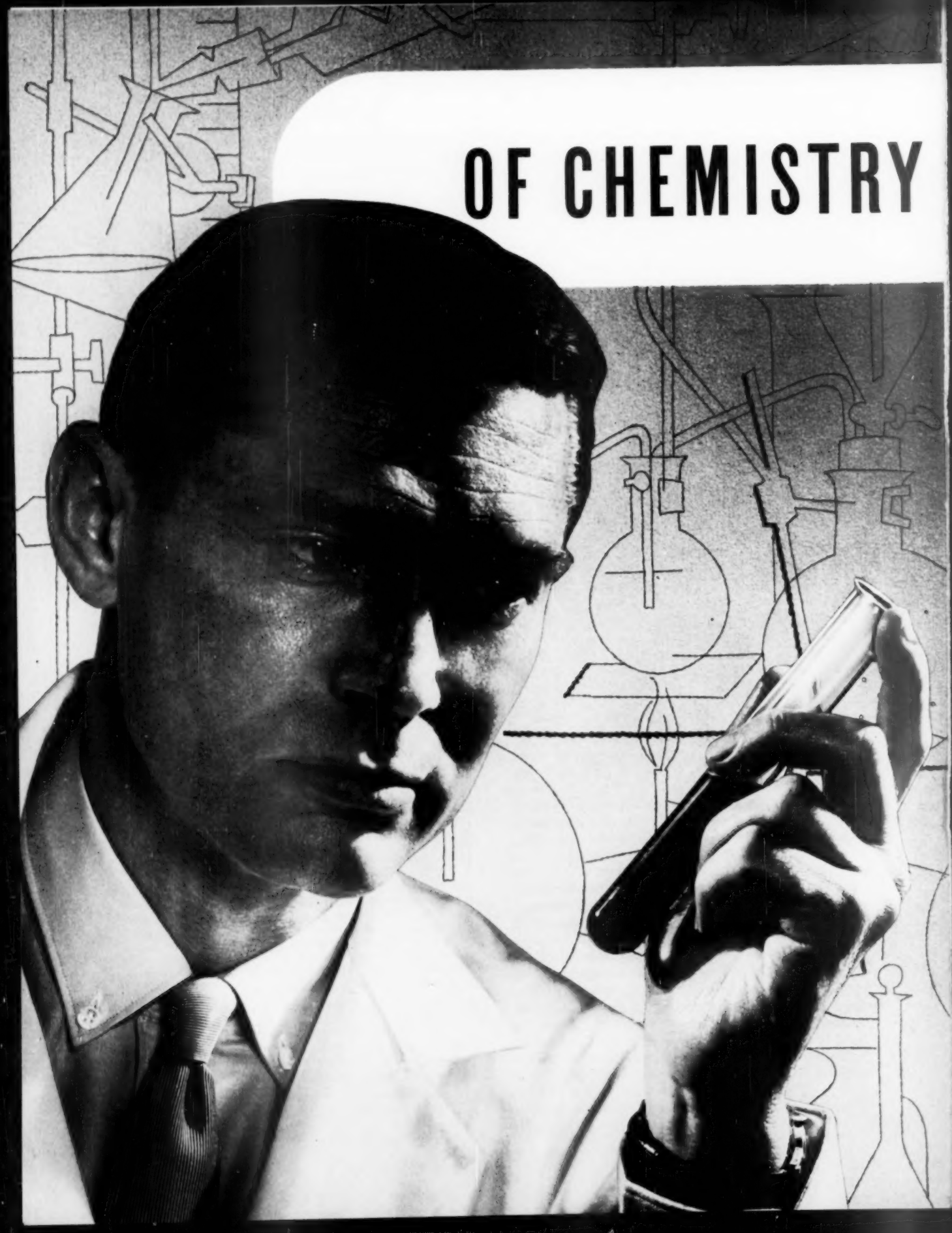
Spectrophotometric determination of aliphatic sulfides.

HASTINGS, S. H. *Anal. Chem., 25,* 420-2 (1953).

It has been found that iodine forms complexes with aliphatic sulfides which have unique ultraviolet absorptivities several orders of magnitude greater than any of the major constituents in petroleum fractions boiling below about 450° F. An analytical

* These Selected Abstracts are made available to FOOD TECHNOLOGY through the cooperation of Associate Editor H. A. Campbell and the General Foods Corporation of New York, N. Y. The abbreviations found in these abstracts are similar to those used by Chemical Abstracts.

(Continued on page 26 following technical papers)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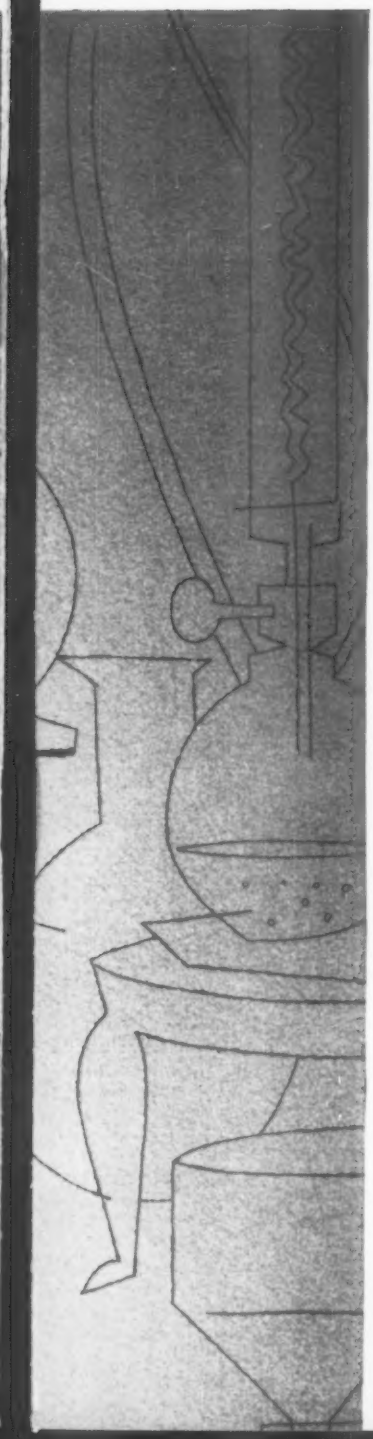

In Pfizer research laboratories, the language of the cash register . . . in terms of profits for food processors . . . is spoken as fluently as the language of chemistry. That's because Pfizer chemists are constantly searching for better ways to

1. CUT PROCESSING COSTS IN FOOD PLANTS
2. GIVE ESTABLISHED FOOD PRODUCTS GREATER SALES APPEAL
3. HELP CREATE NEW AND BETTER FOOD PRODUCTS
4. SIMPLIFY HANDLING

All four have a single aim: greater profits for food processors.

Take Pfizer **CITRIC ACID ANHYDROUS** for example. As an acidulant for carbonated beverages, sherbets, gelatin desserts, jams and jellies, this Pfizer development enhances natural fruit flavor, giving these foods greater sales appeal. Having no water of crystallization, it has important advantages over hydrous citric acid. It cannot dry out, even after months of storage . . . it does not cake under proper storage conditions nor absorb water from the atmosphere. The absence of water of crystallization makes it possible to prepare stable dry food mixes which otherwise would cake badly in storage. Greater uniformity of acidulation is possible because the composition remains constant. And Pfizer Citric Acid Anhydrous can cut freight costs because there's no water to ship.

ASCORBIC ACID . . . Vitamin C . . . is widely used as an antioxidant to retard the development of off-color, off-flavor and rancidity. Packers of frozen fruits and fish have for many years recognized the added sales appeal gained by adding Pfizer Ascorbic to their packs. As an antioxidant, Ascorbic is also favored in preparing beverages and processed foods where oxidative spoilage is a problem. Processors of juices, concentrates and fruit ades, too, will find Pfizer Ascorbic a sales builder when used to standardize the Vitamin C content of their brands.

VITAMIN B_{12} . . . this newest member of the Vitamin B Complex offers great promise in the field of nutrition. Recent clinical research has indicated that Vitamin B_{12} exerts a growth-promoting effect when given as a dietary supplement to children with growth failure. Both Vitamin B_{12} Oral Grade Solids and B_{12} Crystalline have been found to be equally effective. Since Pfizer Oral Grade Solids is the less expensive form, it will be of especial interest in fortifying foods.

Pfizer maintains a skilled staff of technicians ready to assist you in food processing problems. For technical assistance or additional information on these products write:

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ANSWERS TO YOUR QUESTIONS ABOUT ROCHE VITAMIN A

Q. *What is Roche vitamin A?*

A. It is vitamin A, the product of a synthesis which starts with Citral, from lemon grass oil. It is identical biologically with the vitamin A from other sources, such as fish livers. A Roche research team directed by Dr. Otto Isler announced their famous synthesis in 1947. This successful, economical process is now used to produce vitamin A of superb quality by the tors at Roche Park.

Q. *Does Roche vitamin A have a "fishy" odor or taste?*

A. None whatever, nor is there any "fishy burp." In fact, Roche vitamin A has almost no odor or taste and so is preferred for processed foods such as margarine.

Q. *Will I be able to get a steady supply of Roche vitamin A?*

A. You will. The entire commercial needs of the food and pharmaceutical industries of the United States and Canada could be met from our Nutley plant.

Q. *Can I be sure of a "standard" product?*

A. You can. Roche vitamin A is manufactured under strict laboratory control. It is more stable. It is uniform. The regular commercial types of Roche material, if diluted to 50,000 to 65,000 units per gram, will meet the specifications of U.S.P. XIV for oleovitamin A. It is a product of excellent quality.

Q. *What about price?*

A. Roche vitamin A is not subject to wide fluctuation of price, as has been true with vitamin A from natural sources. This can mean large savings for you as there is no need to carry large inventories as was the case prior to the introduction of Roche vitamin A in 1950. Never before has the purchaser been assured of such low prices, consistent with quality and uniformity.

Q. *How is Roche vitamin A packed?*

A. All Roche vitamin A is packed under conditions which assure its stability in customary shipment and storage.

Q. *Can I get help from Roche in using vitamin A in my products?*

A. Yes, certainly! Roche technical experts who supplied so much data at the hearings for amended Definitions and Standards of Identity for Margarine are always at your service. It is important to you that Roche specializes in the manufacture of vitamins.

Q. *Is Roche vitamin A available in different types and potencies?*

A. It is. The following table shows the types most popular in food manufacturing.

TYPE	DESCRIPTION	POTENCY	ADDITIVE*
P1MO	Vitamin A palmitate	1,000,000 U.S.P. XIV units per gram	Edible oil only for standardization
P1.3	Vitamin A palmitate	Ranging between 1,250,000 and 1,500,000 U.S.P. XIV units per gram	None
A1MO	Vitamin A acetate	1,000,000 U.S.P. XIV units per gram	Edible oil only for standardization

*Antioxidants or other additives are included on customer's specifications.

Notes: Type P1MO has less tendency to crystallize during storage and handling than higher concentrations of vitamin A palmitate and acetate.

Type P1.3 is more susceptible to crystallization than type P1MO but can be handled without difficulty when using certain precautions.

Q. *Are special blends available for the margarine industry?*

A. Yes. Roche will supply blends to your specifications. A modern blending and canning plant is at your service.

Q. *What kind of service can I expect on special blends?*

A. The best—with special attention to accuracy, quality and control.

ROCHE

Vitamin A acetate and palmitate

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In Canada: Hoffmann-La Roche Ltd.
286 St. Paul Street, West, Montreal, Quebec

Status of Proposed Amendments Affecting Chemical Additives[a, b]

BERNARD L. OSER

Food Research Laboratories, Inc., Long Island City, N. Y.

(Manuscript received June 23, 1953)

Ethical, economic and legal considerations require that the food industry insure the public of a food supply that is safe, clean, and nutritious. The Federal law governing the purity and the honesty of foods is a criminal law. For these reasons it behooves food scientists and technologists to be constantly aware of the scope and requirements of the laws under which they operate, and to contribute of their knowledge as a basis for the orderly and rational development of these laws. At the very least they should be cognizant of any proposals for amending the laws wherever they may emanate. Especially is this the case when contemplated amendments are likely to influence the course of technological developments or perhaps to reduce the incentive which industry must have for the support of research leading to new or improved products.

You are all well aware that amendments to the Federal Food, Drug and Cosmetic Act are presently under consideration. The subject has been extensively discussed at this and previous meetings of the Institute of Food Technologists. It is my present purpose to report to you the proposals that have been made at the present session of Congress, with particular regard to the regulation of new chemical additives to foods. Certain aspects of the current bills will be compared and various reactions to these proposals will be discussed. Despite the fact that these bills have already been introduced in the first session of the 83rd Congress, there is little likelihood that they will be taken up before 1954; hence there is still time for the public and for industry to make known their wishes to Congress.

When amendments to our basic laws are proposed it seems reasonable to consider first, whether there is a real need for modifying or expanding the existing law, second, the nature and extent of this need, and finally, whether the proposals adequately and equitably satisfy it.

ADULTERATION AND MISBRANDING PROVISIONS

The provisions of the law as it now stands which regulate the presence of chemical additives in foods come under the headings of adulteration and misbranding. A food is adulterated if it bears or contains any poisonous or deleterious substance which may render it injurious to health. Another section of the Act specifies that "any poisonous or deleterious substance added to any food, except where such substances are required in the production thereof or cannot be avoided by good manufacturing practice shall be deemed to be unsafe" and hence are proscribed under the adulteration section. Under exceptional circumstances, however, the Administrator—now the Secretary of Health, Education and Welfare—is required to promulgate regulations establishing tolerance limits to the extent he finds necessary to protect the public health. These are arrived at as a result of public hearings at which evidence is adduced to establish (a) the necessity for the presence of such ingredients, (b) the quantity required in production or unavoidable in manufacture. It should be noted that the basis for fixing tolerance levels is not simply "safety" *per se* but practical need, bearing in mind that the substance under consideration is a poisonous or deleterious one.

It is evident that the construction of this part of the law hinges upon the definition of "poisonous or deleterious substance." The legal mechanisms through which these provisions of the law are enforced are, stated simply, seizure and court action in which the Government, that is the Food and Drug Administration, has the burden of proof.

In addition to these methods of preventing or controlling the presence of chemicals in foods, the present law makes certain provisions for the declaration of ingredients on labels. A food is misbranded if it contains an ingredient whose presence is not declared or if it is a food for which a definition and standard of identity has been prescribed and it contains an ingredient for which no allowance is made in the definition and standard. Thus by specifying in a standard of identity for any food those ingredients which are mandatory, optional or permissive, a direct control is exercised over the presence of chemical additives in standardized foods. The standardization procedure involves public hearings and in recent years an inordinately large part of the time consumed by these hearings has been devoted to the taking of evidence on the safety of chemical ingredients. This experience has convinced many authorities that the determination of safety of new chemical additives ought not to be subject to food standards procedures but rather be handled by an independent scientific group in less formal prehearing discussions. The Food and Nutrition Board of the National Research Council has recently come out in support of such an objective.

The misbranding provisions of the Act can be invoked to prevent the presence of accidental or incidental chemical additives in foods. For example a component of the wrapping or packaging material may be absorbed into a food but under such circumstances, its presence would not normally be declared as an "ingredient." Under the misbranding provision control over chemical additives is based on non-conformity to a standard or

[a] Presented at the Thirteenth Annual Meeting of the IFT, Boston, Massachusetts, June 23, 1953.

[b] This paper is one of the contributions to the "Chemicals in Food" Session, conducted under the chairmanship of Dr. Charles N. Frey. The remaining papers of this series will appear in a subsequent issue.

to a label declaration rather than on the question of injuriousness.

SOME BASIC ASPECTS OF CURRENT LEGISLATIVE PROPOSALS

Present controls over chemical additives, except via the standards-making process, are actually *ex post facto* controls. In other words, after the offending substance is found to be present in foods that have moved in interstate commerce, the Government has the often difficult burden of establishing its harmful properties by court proof. The protection afforded by standards, on the other hand, is limited only to those foods that are the subject of standards. The attention drawn to the prolonged and expensive public hearings, particularly those concerned with bread standards, was largely responsible for the appointment of a special Congressional committee to investigate the use of chemicals in food products, the so-called Delaney Committee. Alarmist articles in popular magazines and newspapers have propagated exaggerated ideas of the dangers to which the unsuspecting pubic is exposed by a "conscienceless" industry. A further sequel of this situation was the appointment of the Food Protection Committee by the Food and Nutrition Board of the National Research Council for the purpose of independently and objectively reviewing all available information on the proper use of both incidental and intentional chemical additives. The Food Protection Committee, is, as you have heard today, actively studying many facets of this situation and has already published several valuable and informative reports to which reference has been made by Dr. Hand.[e] However, it is not the intention of the National Research Council either to propose or to participate in the drafting of legislation but rather to provide basic information and guidance to the Government and to the industries affected.

The hearings of the Delaney Committee were begun in the fall of 1950 and terminated in the spring of 1952. The transcript of the hearings together with the reports of the Committee fill 2800 printed pages. On the basis of this record bills have been introduced into the House of Representatives by the Chairman of the Committee, Hon. James J. Delaney, and by one of its members, Hon. A. L. Miller (incidentally a physician and surgeon).

Mr. Delaney's bills provide for the regulation of chemicals in cosmetics (H. R. 2244) and of chemical additives (including pesticides) in food (H. R. 2245). Dr. Miller has very wisely separated the problem of control of pesticides (H. R. 4277) from that of chemical additives in foods (H. R. 4901), and it is understood that he will introduce another bill providing for the regulation of cosmetic chemicals. [These are not to be confused with the Miller Bill (H. R. 3257) of the previous session of Congress].

It has been suggested that the Delaney bills have had the support and silent blessing of the Food and Drug Administration whereas the Miller bills are, to a greater degree, responsive to the agricultural and industrial viewpoint. Be that as it may, the Delaney and Miller bills differ in certain fundamental respects despite the similarity of their aims and purposes.

The fact that in both bills the definitions of "chemical additives" agree in most particulars attracts attention to their points of disagreement. Both bills adopt the Food Protection Committee's concept of a chemical additive as any substance used (in whole or in part) as a food, or in processing, packing, transporting, wrapping, or holding food. However, the definitions provide further that an additive must not be generally recognized among experts who are qualified by scientific training and experience to evaluate the safety (H. R. 2245) or toxicity (H. R. 4901) of such substances as having been adequately tested to show that it is safe for the use for which intended. In addition to the uses in processing, packing, etc. as indicated above, the Delaney bill includes use in "producing" whereas Dr. Miller's includes use in "manufacturing"; however, the latter considers pesticides (which are employed principally in production) in a separate bill.

As though this definition were not complete enough, the Miller bill (H. R. 4901) adds to the foregoing uses "for use as artificial coloring, synthetic flavors, sweeteners, vitamins for enriching bread, mold inhibitors, bactericides, antioxidants, emulsifiers, and minerals whether it be intentional or incidental." It is presumed that "sweeteners" in this context mean chemical or synthetic agents, and not sugars derived from natural sources. It is not obvious why vitamins have been limited to those used for enriching bread or why indeed they should be specified at all if vitamins used for enriching margarine, breakfast cereals, beverages, etc. could come into the definition by virtue of their "altering any food." In fact, this entire paragraph which is derived from examples cited in a Food Protection Committee statement, [Section 201(2)(4)], would seem to be redundant.

It may be pointed out that according to these definitions a substance is not a chemical additive unless it is "not generally recognized . . . as having been adequately tested." Would this mean that if qualified experts were to advise a food manufacturer that a substance *has* been adequately tested to show that it is safe for an intended use, it is not a chemical additive by definition? Or does it mean that the adequacy of the testing must be determined by the Administrator's experts who alone would be considered qualified to make such evaluations? Will the Administrator say that sodium benzoate, because it has been adequately tested to establish its safety, is not a chemical additive? Under the present definition filing a petition for a chemical additive is tantamount to an admission that it has not been generally recognized among qualified experts to have been adequately tested to show that it is safe.

It is to be noted that both the Delaney and the Miller bills aim the regulatory procedure toward the chemical additives *per se* rather than toward the food in which it may be present. Thus the major responsibility for filing a petition may be expected to rest upon the chemical

[e] Reference is made to the report by Dr. David B. Hand (New York State Agricultural Exp. Sta., Geneva, New York) on the work of the Food Protection Committee, one of the contributions to the "Chemicals in Foods" Session.

manufacturer rather than the food processor. However, since the definition of chemical additives is allied to their intended use it would be incumbent upon the chemical manufacturer, if he were the applicant, to become fully informed as to the directions, recommendations, and suggestions for each proposed use of his products. In addition to information concerning composition, methods of analysis, directions for use, etc. both the Delaney and Miller bills require that reports be furnished of investigations made to determine whether the additive is safe for the use for which it is intended. If this part of the procedure operates in the same manner as the new drug provisions of the Food, Drug and Cosmetic Act, toxicological data might have to be presented for each proposed use of a chemical additive.

In addition to the information discussed above, applications for the use of pesticides, according to H. R. 4277, are required to specify the name, chemical identity, and composition of the pesticide, the amount, frequency, and time of application, toxicity information, tests showing the amount of residues remaining, proposed tolerances (if tolerances are proposed), and reasonable grounds in support of the petition. In establishing tolerance regulations the Administrator is required to "give appropriate consideration to the necessity for the production of an adequate and wholesome food supply."

The amendments that have been proposed specify the factors the Administrator must take into account in determining whether or not to issue an order approving the use of a chemical additive. In H. R. 2245 consideration must be given to the extent to which the substance is required in or on such food, other ways in which the consumer may be affected by the same substance or other substance, and of course the adequacy of the information submitted in the petition.

In addition to these considerations H. R. 4901 provides that the Administrator shall refuse a permit if he finds that upon the basis of any information with respect to the chemical, even apart from that submitted in the application, he has insufficient information to determine whether it is safe for the proposed use.

TWO MAJOR POINTS OF CONTROVERSY

As I pointed out in a paper presented last year before the American Chemical Society,[4] there appeared to me to be two major points of controversy between the Government and the chemical industry as represented respectively by the bill proposed by Rep. Miller in the previous session of Congress, (H. R. 3257), upon which no action was taken but which was said to have the support of the Food and Drug Administration, and the proposals advanced by the Manufacturing Chemists' Association. These controversial issues related first to whether the petitioner had to assume the burden of proving safety or the Government would continue to accept the responsibility of proving harmfulness when the question arose in the courts; and, second, the extent to which the Administrator's decisions—and particularly his "findings of fact"—were to be subject to judicial review.

[4] Oser, B. L., Food Needs and Food Laws, *Chem. and Eng. News*, 30, 4827 (1952).

From what I have said so far it is apparent that the proposed amendments will make it incumbent upon the petitioner to bear the full burden of proof of safety. Most manufacturers appear willing to accept as a legal requirement what they already regard as an ethical responsibility. The recent voluntary withdrawal of coumarin from food channels by the principal manufacturers of this flavoring compound is an excellent example of the attitude of the chemical industry toward this obligation to the public. Such objections to this proposal as may have been implicit in the counterproposal of the Manufacturing Chemists' Association for notification rather than prior approval probably had their genesis in the long delays experienced in the issuance of tolerance regulations. For example, though Insecticide Residue Hearings were terminated in 1951, the findings of fact and proposed regulations have not been issued to this day.

The second and perhaps more controversial provision of the original Miller bill was that the Administator's findings of fact, if based on substantial evidence, were to be conclusive in the event of appeal to a Circuit Court. This has been regarded as giving too large a measure of finality to the Administrator's decisions in promulgating the regulations which he is empowered to enforce. The report of the Delaney Committee recognized the need to make "adequate provisions for a comprehensive judicial review of administrative decisions." The interposition of an advisory committee between the Administrator and the appellate court was supported by many witnesses before the Delaney committee including M.D.'s associated with the practice and teaching of medical subjects.

Various proposals have been advanced to achieve this objective more effectively than this proviso in the original Miller bill, including one which I outlined in considerable detail in the paper to which I have referred. This recommendation provided for the appointment of an independent board of scientists to whom an applicant could appeal for a review of the Administrator's findings. On the basis of its evaluation of the evidence the board's findings and recommendations were to be submitted to both the applicant and the Administrator following which the latter would then have the option of modifying his order. In any event if the applicant should then wish to appeal the final order to the courts, the record would include the findings and recommendations of the independent board as well as those of the Administrator.

This is substantially the procedure for review provided for in the Miller bills (H. R. 4901 and H. R. 4277). On the other hand it should be pointed out that the Delaney bill (H. R. 2245) has no provision for review of the Administrator's findings of fact or regulations except by appeal to the Circuit Court in accordance with Section 701(f) of the Food, Drug and Cosmetic Act.

According to the Miller bills, a petitioner may, within 90 days after filing, request referral to an Advisory Committee, or the Administrator, if he deems it necessary, may on his own volition refer a petition to an Advisory Committee. Within 60 days thereafter the

Food or Pesticides Advisory Committee, as the case may be, "after independent study of the data submitted to it by the Administrator and other data before it" files a report and recommendations on the proposal in the petition to the Administrator. After giving appropriate consideration to all the data before him including the report and recommendations of the Advisory Committee, the Administrator then makes public a regulation approving or disapproving the application.

In other words, the findings or recommendations of the Advisory Committee are not binding upon the Administrator. However, the bill further provides that any person adversely affected by the Administrator's final order may appeal to a United States District Court whereupon a transcript of the entire record including the Administrator's findings, conclusions and order as well as any report or recommendations of the Advisory Committee are filed in the Court. The Court then has exclusive jurisdiction to affirm or set aside the order or to make findings of fact on the evidence which is considered *de novo*. The Court can then order the Administrator to modify or amend his order but this judgment is subject to review by the Supreme Court upon *certiorari*.

H. R. 4277 relating to pesticides contains certain provisions for review which do not appear in H. R. 4901, the bill relating to chemical additives in foods. In addition to providing that the District Court shall consider and weigh the evidence before it *de novo*, it states that "no presumptive force or effect shall be given to the validity of the order complained of." It provides further that the Court may order additional evidence to be taken before the Administrator if such evidence is material, and there were reasonable grounds for failure to adduce it in the earlier proceedings.

These provisions for review would seem to be sufficiently comprehensive to provide all the protection needed against what Rep. Miller has called "the dictatorial powers of the Administrator of the food and drug laws (who is) the witness, the prosecutor, the jury, the judge, and the executor."

If nothing else, these provisions for comprehensive review alone should make the Miller bills more acceptable to the agricultural and food industries than the Delaney bills. Organizations like the National Agricultural Chemicals Association, various farm organizations, and land grant colleges have already supported H. R. 4277, although the Manufacturing Chemists' Association has not yet taken an official stand.

Various more or less definite suggestions were made by witnesses before the Delaney Committee as to the composition of advisory committees. The Miller bills propose that they be composed of "experts, particularly qualified in the specific subject matter of the petition, selected by the Administrator, by the person filing the petition, and by the Chairman of the Food Protection Committee of the National Research Council, the same number of experts to be selected by each." This, of course, contemplates a special committee to consider each individual petition for which review is requested. Some objection to advisory committees has been raised on the ground, *inter alia*, that they are cumbersome. This criticism may apply with greater force to separate committees for each problem than to a standing advisory committee comprised, as I have suggested in a previous paper, of members selected from the societies representing the major scientific disciplines involved in the evaluation of the safety of foods. Such a standing committee, according to my proposal, would be empowered to invite the testimony or opinions of experts in the fields specifically pertinent to the problem at hand.

The adoption of an amendment requiring prior approval of chemical additives will serve to eliminate questions of toxicity from standards hearings with consequent saving of time and expense to both the Government and industry. It would permit the weighing of highly technical evidence and the resolution of questions of interpretation and judgment in an atmosphere of scientific inquiry rather than in the formal, sometimes inquisitorial, manner of the court room.

The objective of expediting the standards-making process would also be served by the passage of another proposed amendment (H. R. 5055). This would make possible the promulgation of standards on the basis of informal conferences rather than public hearings, in those cases where no controversies are involved. Incidentally Mr. Michael F. Markel, the well-known food and drug lawyer who was largely responsible for the drafting and introduction of this proposal, recalls that the provisions of the present law for formal, public hearings on food standards were originally included at the strenuous insistence of industry over some Government objection.

The Markel proposal has been endorsed by the Food, Drug, and Cosmetic Law Section of the New York Bar Association and, in substance, by the Food and Nutrition Board of the National Research Council.

In the interest of counteracting the tendency of food standards to impede research and development in new fields, the latter Board has also gone on record as favoring an extension of the Administrator's discretionary authority to issue temporary permits. This recommendation would have the effect of allowing the test-marketing of "new and nutritionally or economically desirable food products which, although different in composition, are sufficiently similar to or in semblance of standardized foods" to come possibly within the prohibition of Section 403(g) whereby a food is misbranded if it "purports to be" a standardized food but fails to conform to the definition and standard of identity. This recommendation has not yet been made the subject of a proposed amendment but the present outlook seems to be in that direction.

A LOOK AHEAD

From the foregoing discussion it is apparent that years of discussion and hearings on food standards, chemical additives, and pesticides are serving to crystallize thought on the part of industrial and Governmental scientists and lawyers and it may be expected that they will culminate in progressive legislative action within the next year or so.

Although they do not fall into the category of legislation dealing with chemical additives, two court actions

of the past year are of interest to those whose work comes within the ambit of the Food, Drug, and Cosmetic Act. In one of these, the so-called Cardiff decision, the Government's right to send inspectors into food plants was contested. The U. S. Supreme Court held that interpretation of the Food, Drug, and Cosmetic Act as making a crime of refusal to permit entry and inspection is invalid, inasmuch as the Act does not give the plant manager fair and effective notice that if he fails to give consent he is a criminal. Attacking the confusing and contradictory language of the Act, the Court said: "The vice of vagueness in criminal statutes is the treachery they conceal either in determining what persons are included or what acts are prohibited. Words which are vague and fluid may be as much of a trap for the innocent as the ancient laws of Caligula. We cannot sanction taking a man by the heels for refusing to grant the permission which this Act on its face apparently gave him the right to withhold." Would that these thoughts were always in the minds of those charged with drafting laws and regulations capable of making criminals of the unwary.

As a result of the decision in this case, legislative wheels are turning toward amendment of the law so as to reinstate the Food and Drug Administration's factory inspection activities on the basis that no prior notice or consent need be given. Thus far, hearings on a proposed amendment have established that there is general agrement as to the right of the F. D. A. to inspect. However, a controversy has arisen as to whether such "inspection" should extend to mandatory disclosure of quantitative formulas, trade secrets, complaint files, and similar confidential data. It remains to be determined whether a proposed amendment will specifically define the scope of federal inspection. It is expected that a bill will be reported out by the House Interstate Committee this week but its immediate future is uncertain since Representative O'Hara, a member of the Committee, has indicated he will oppose the legislation on constitutional grounds.* It will be recalled that President Eisenhower and Secretary Hobby in a televised cabinet conference a few weeks ago, stressed the importance of this legislation.

A recent case before the Wisconsin Supreme Court was in part a challenge of the constitutionality of a portion of the statutory definition of drugs which was alleged to constitute an unlawful delegation of legislative authority to the compilers of the official compendia, *viz., the U. S. Pharmacopeia*, the *National Formulary*, and the *Homeopathic Pharmacopeia*.

The Court held, in effect, that while the legislature could not delegate its power to make laws, it could make a law delegating the power to determine facts upon which the operation of the law will depend. Hence the provision for the admission of new discoveries into a standard compendium, subject to the approval of qualified and eminent scientists, is not a delegation of legislative powers. While this decision was based specifically on a case involving the sale of proprietary medicines, it would seem to have significance in relation to the question of those regulations- and standards-making powers which are delegated to administrative or, at any rate, non-legislative, authorities.

To revert to my opening remarks, these are times when food manufacturers generally and food technologists specifically should give thoughtful consideration to any contemplated legislation or regulations which may affect their activities in the field of research and development. Even the practical questions of labeling and merchandising often require interpretation of a scientific or technological nature and these, too, demand at least a background knowledge of the food laws. Finally, our legal experts, in order more effectively to achieve rational, sound, and understandable legislation for the good of all concerned with the food supply, should have the constant aid and cooperation of scientists and technologists.

Addendum

The above was written during the early part of June 1953. In the closing hours of the last session of Congress, a bid was passed, and subsequently signed by the President, granting authority for factory inspection to the Food and Drug Administration. It provides that any establishment where foods (also drugs, cosmetics and devices) are manufactured, processed, packed or held prior to, during or after introduction into interstate commerce (even including vehicles) may be inspected upon presentation of appropriate credentials and a written notice to the owner, operator, or agent in charge. Inspections must be made "at reasonable times . . . within reasonable limits . . . in a reasonable manner . . . (and) . . . with reasonable promptness."

The scope of "inspection" is not specifically defined in the wording of the amendment itself but this is considered to be limited by the legislative history of the bill. Inspection may be made of ingredients and products from the raw to the finished state, equipment, procedures, containers and labeling. Quantitative formulas, personnel records, complaint files, and prescription files were excluded from mandatory inspection after considerable debate in which the views expressed in the House prevailed over those of the Senate.

The new Section 704 further provides that upon completion of the inspection, the inspector shall leave a written report of his findings relative to conditions or practices indicating that the food, etc. consists in whole or in part of a filthy, putrid, or decomposed substance or has been prepared, packed, or held under conditions likely to result in such contamination or in possible injury to health. The inspector is required to leave a receipt for any samples taken. A copy of the results of analyses of such samples is to be furnished promptly to the owner, operator, or agent in charge

For a full understanding of the scope of this amendment it is urged that the majority and minority reports of the Committee on Interstate and Foreign Commerce accompanying the Bill (H.R. 5740) be studied.

* On June 15, 1953, Rep. Wolverton introduced H.R. 5740 which was passed by Congress on the final day (August 3, 1953) of the session.

Aging, Nutrition, and Public Health[a]

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(Manuscript received June 22, 1953)

Two emerging concepts in public health today—health maintenance and constructive medicine—may well be applied with regard to nutrition and our aging population. We have made great strides against deficiency diseases, such as pellagra, beriberi, rickets and goiter. While performing our day-to-day task of maintaining and extending these advances, we can now think in terms of constructive, or optimum nutrition, with its implications for promoting healthful, productive longevity.

Medicine today is vigorously attacking the health problems associated with age, and moreover is accepting the challenge of aging itself. We seek to refute the discouraging idea that the so-called degenerative processes are inevitable—simply a matter of "growing old." Indeed, there is much evidence to the contrary. A centenarian may have arteries with far fewer lesions than a person of 50, and cancer is the leading disease killer among children 5 through 14 *(23)*.

Albert I. Lansing, describing recent studies with small water animals, suggests that aging may be connected with some specific substance, either an accumulating toxin or a diminishing essential material. "These experiments," he concludes, "by no means suggest a key to immortality. But they do challenge the defeatist doctrine of the inevitability of aging, and encourage a quest for the biological characteristics of the aging process" *(18)*.

Role of nutrition in aging. What, then, is the role of nutrition in these problems, and in maintaining optimum health into the later years? This is a subject most pertinent to our times.

The population of the United States is steadily changing in two major ways.[b] First, it is growing larger, and secondly, older. Chart 1 illustrates the increase in the total population since the turn of the century and projects the trend to 1960. Some conception of the rate of growth can be gained from the fact that during my talk today, the population will have increased by about 135 persons—one every 13 seconds.

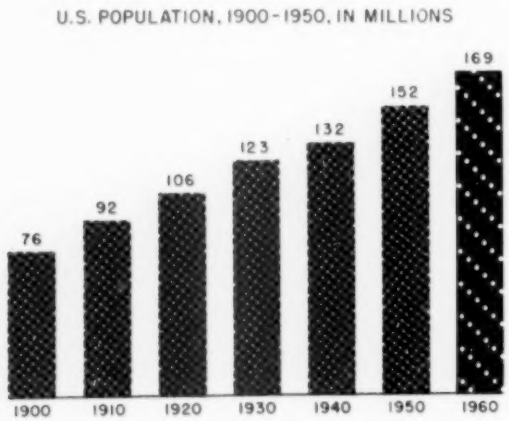

Chart 1.

A principal reason for these changes in the population has been gains in health, as shown in Chart 2.

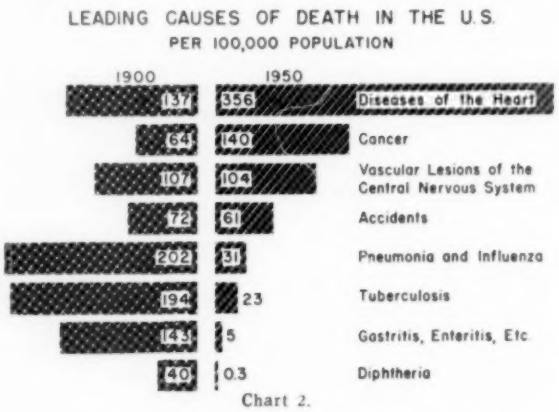

Chart 2.

These, for the most part, have been against infectious diseases, many of which take their greatest toll in infancy and youth. Moreover, maternal and infant death rates have declined to unprecedented levels. As a result of these advances, the average life span has progressively lengthened. Between 1850 and 1900, the increase was about 2 years per decade, and during the past 50 years, the rate has nearly doubled. More people are reaching maturity and old age.

Chart 3 shows the effect of this trend upon the composition of the population. We see that the older-age group is increasing not only in size, but in proportion.

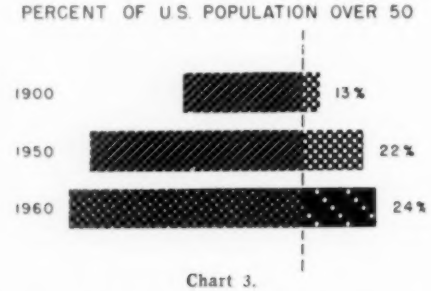

Chart 3.

By 1960, nearly a quarter of the people will be over 50, representing a four-fold increase in this group since 1900. I think you will agree that this aging of the population is a rather striking trend, and one of great significance.

Now, what are the health characteristics of the older groups? Unfortunately, they present serious health problems, with drastic social and economic effects.

[a] Delivered at the Thirteenth Annual Meeting of the Institute of Food Technologists, Boston, June 22, 1953.

[b] All material in charts is from the National Office of Vital Statistics, Public Health Service, May 1953.

Chart 4, based on the National Health Survey of 1936, shows that each older age group contains a higher proportion of disabled persons. This imposes a tremendous socio-economic burden as well as incalculable suffering. Again we may raise the question, Is this inevitable? Edward J. Stieglitz has noted: "Most of the disablement, misery, and uselessness of those past the so-called prime of life is consequent to chronic progressive disease and not to age alone" *(27)*.

If we project disability figures into the future, we find that the number of disabling illnesses in the United States lasting a week or longer will be 25 to 30% higher by 1960, and perhaps 40 to 50% higher by 1975 *(24)*. This trend might be altered, of course, by a breakthrough in our attack on the major disabling diseases—atherosclerosis, for example. This is the most serious form of hardening of the arteries, causing 9 out of 10 heart attacks and seriously disabling hundreds of thousands of our people. I shall discuss later a promising research approach to atherosclerosis, the major disease of our time.

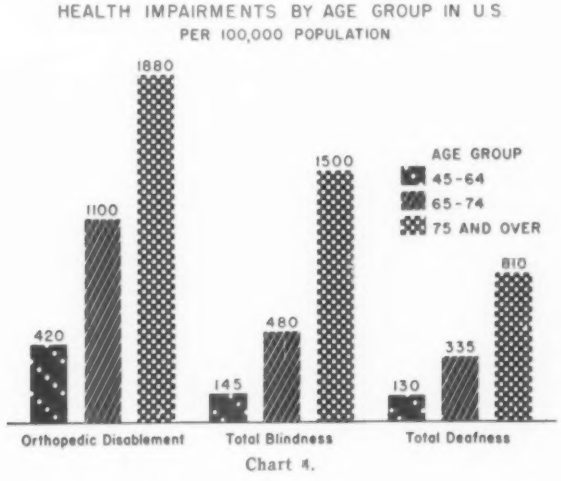

Chart 4.

Similar to the picture of disability among the aged is that of the fatal illnesses: the older the group, the larger the proportion of chronic disease deaths. Heart disease causes almost half the deaths among persons 65 and over. In this age group, other leading killers are cancer, diabetes, influenza, pneumonia, and chronic nephritis.

Our relatively slight progress against chronic disease is reflected in the life expectancy of the middle-aged. In Chart 5, the increase in life expectancy from birth is compared with that from age 50. Whereas the total life span of white males has risen about 18½ years since 1900, the life expectancy of 50-year-olds is higher by little more than 2 years. An even more striking comparison can be made if we go back a century, using 1850 data for Massachusetts as roughly representative of the country as a whole. The improvement in life expectancy from birth is over 28 years; from age 50, only 1½ years. And in well-developed European countries, the trends have been similar. In Scotland, for example, the improvements between 1870 and 1949 were

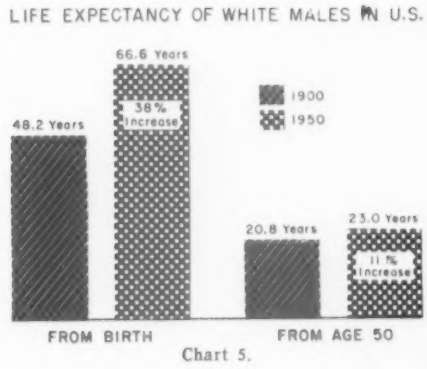

Chart 5.

about 23½ years from birth and only 2 years from age 55. These comparisons emphasize that our health gains, for the most part, have been against diseases of the young, and that older people are nearly as vulnerable to the major chronic diseases now as they were 50 or 100 years ago.

A two-fold problem. Our aging population, then, presents a two-fold problem. First, disability: to keep the older people healthy and productive. Secondly, chronic disease mortality: to add years of life through medical research and disease control. And parallel with these needs is another I have mentioned: to learn more about the aging process itself, with a view to realizing our full age potential.

Aging, nutrition, and public health are directly related in various ways. Primary concerns are the special feeding problems and nutritional needs of old people. Then too, nutrition problems are common in the treatment of chronic diseases—for example, when digestion is impaired; and closely related is therapy by dietary means, as in diabetes and gout. I shall emphasize today, however, nutrition in yet another relation. I refer to chronic disease research, in which a major objective is a better understanding of the body's utilization of nutrients—in a word, metabolism.

In much of this effort, primary attention is given to the complex interrelation of nutrients with enzymes, hormones, and other metabolic agents. Encouraging progress has been made, but our knowledge is still fragmentary and requires much supplementation. In other research not directly concerned with nutrition, knowledge and techniques are being developed that can be readily applied in the nutrition field.

An important but little understood link between nutrition and chronic disease is obesity—a major problem called sharply to attention by actuarial experience, and now investigated in several laboratories. About a quarter of the adult population is sufficiently overweight to impair health *(7)*. I shall touch on the subject only briefly, since Dr. Jolliffe[c] will discuss it in some detail.

No better understood than the role of obesity in disease is the relation between obesity and the aging process. As we pass through the middle years, the percentage of body fat usually rises, though the over-all weight may remain the same *(6)*. Thus, among groups

[c] Dr. Jolliffe's paper, "Obesity and its Management as a Clinical Problem," will appear in a subsequent issue.

of standard weight, fat may comprise only 10% of the body weight in younger men, as compared with 21% in older ones. The prevalence of obesity increases to about age 40 for men and 50 for women, and declines after age 60 *(4)*. This decline is due not only to loss of fat, but also to the loss of fat people.

The fact that obesity is correlated with aging and chronic disease does not in itself imply a causal relation. Unknown etiologic factors may be common to these conditions. In various studies, however, caloric restriction has prevented cancer in mice *(28)*, prolonged greatly the life of rats *(18)*, and reduced the signs of diabetes in humans *(1)*. Moreover, striking decreases in the incidence and severity of diabetes and hypertension accompanied undernutrition and loss of weight in certain European countries during both World Wars *(15)*. We may reasonably assume, then, that practical advances against obesity would have far-reaching effects upon public health.

This problem is fertile for research. We should like to know for example, what benefits in longevity accrue to the middle-aged person who reduces and maintains the reduction. We need clarification of the mechanism, psychological or metabolic, that leads to overeating. We should define the role of heredity—a primary factor in the obesity of certain strains of mice *(19)*. And we may hope that such knowledge will improve our means for controlling obesity through public health programs.

This subject provides a point of transition to the role of fat metabolism in the development of cardiovascular diseases. I have mentioned the prevalence and seriousness of atherosclerosis—a thickening of the inner lining of the artery. Everyone who grows old develops arteriosclerosis that hardens the middle layer, but atherosclerosis, the most serious form, always pushes inward. Deposited cholesterol, a fat-like substance, is a part of this growth.

Observations on patients following weight reduction have shown a decline in circulating cholesterol of the type suspected in this condition *(10)*. To what extent the lower level is due to reduced fat ingestion rather than reduction of weight has not been determined.

Research on atherosclerosis is proceeding along many lines. Most investigators, however, work from the hypothesis that the body's fat-handling system plays a part in the development of the disease. Not only have abnormal cholesterol-bearing molecules been found in the blood of sclerotic patients *(11)*, but some animals on high-cholesterol diets develop sclerotic lesions *(5)*.

Investigators at the National Institutes of Health recently identified a "clearing factor," which diminishes the cloudiness of blood occurring after a fatty meal *(3)*. In normal persons this condition clears automatically within a few hours, but in others it persists, possibly leading to atherosclerosis. The clearing factor not only eliminates the cloudiness, but appears to break down the abnormal cholesterol-bearing molecules that are particularly suspect.

The fact, however, that the body readily synthesizes cholesterol from simple, ever-present substances compels caution. Moreover, we do not yet know whether the dietary level of the substance is of practical significance. Cholesterol metabolism involves such nutrients as choline, other B vitamins, and some amino acids; and various nutritional deficiencies affect the deposition *(16)*. For persons with atherosclerosis, the best diet known at present is a balanced one, such as normal people require. If other problems such as hypertension are involved, a special diet may be indicated.

Cancer is another chronic disease in which nutrition science is contributing valuable information. Dietary manipulations have been shown to exert pronounced effects on cancer causation in animals. Caloric restriction, as I have pointed out, prevents or delays the appearance of various tumors; and restriction of certain amino acids gives similar results *(28)*. Choline deficiency, on the other hand, induces liver cancer in the rat *(8)*. These observations have no immediate practical value, since the preventive diets abolish breeding capacity and choline occurs in a wide variety of foods. Such findings, however, are important leads for further research.

In humans, cancers already established have shown little response to dietary alternations *(2, 12)*; but in animal experiments, alternate restriction and supply of a vitamin, such as riboflavin or pantothenic acid, has appreciably prolonged life *(20)*. Vitamin antagonists have produced similar effects; in some children, chemical antagonists to folic acid, such as aminopterin, have been of temporary benefit in leukemia *(9)*. Recent advances in leukemia concern certain pyrimidine compounds. When administered to animals, these drugs in combination with a folic acid antagonist appear to inhibit neoplastic growth more than antifolics alone *(20)*. For nutritionists, the exploration of such antimetabolites offers rich opportunities for extending knowledge of normal and abnormal growth.

In concluding these remarks on chronic health problems, I should like to mention some nutrition findings with regard to arthritis, the principal crippling disease. The study of arthritis has been hampered by lack of a method for producing the disease in experimental animals. Recently, however, several investigators have produced arthritic changes by dietary means.

At Washington University in St. Louis, a condition resembling osteoarthritis, prevalent in aging people, was induced in mice of a highly inbred strain *(26)*. A high-fat diet was fed to one group, a high protein diet to another. The mice that received the fat-enriched diet showed an acceleration of skeletal aging and an increased incidence of osteoarthritis, whereas protein enrichment retarded aging of the joints and delayed the onset of joint disease.

Other groups of workers, one at Kansas City College and another at Cambridge University, report a disease in vitamin-C-deficient guinea pigs that resembles rheumatoid arthritis. It is interesting that these joint changes can be prevented with cortisone *(13, 17)*.

A recent advance now being applied clinically concerns osteoporosis, a brittle condition of the bones due to decalcification. It is primarily a disease of the aged, but may occur at any age as a late phase of arthritis. At the Russell Sage Institute of Pathology, osteoporosis is

being treated successfully with the metal strontium *(25)*. After maximum calcium storage, strontium can still be stored in the bones. Maximum retention of both minerals is achieved with the aid of auxiliary agents—vitamin D and sex hormones. This, as well as the fact that osteoporosis often results from ovarian insufficiency, clearly suggests a relation between nutrition and hormones for which we have no explanation.

Nutrition science, using new biochemical approaches, offers much promise against diseases of the bones and joints. Even the study of an inorganic nutrient such as calcium presents attractive possibilities. The skeleton is now regarded as a living tissue, particularly in view of tracer studies showing that calcium enters and leaves the skeleton with considerable rapidity. Little is known, however, about the regulation of calcium metabolism. How, for example, is calcium mobilized to the area of a tuberculous lesion? In leprosy, though a bacterial disease, why do entire bones sometimes disappear as a result of resorption? Explanations of such metabolic disturbances could aid in the prevention of arthritic deformity.

These suggestions for future research may help emphasize an important point. Nutrition science has made great strides in the past, but the opportunities for further progress are limitless.

Such long-term investments in fundamental research on the problems of aging represent an approach historically proven to offer the best returns in the long run. There is a constant exchange, of course, between basic and applied science. Your research in nutrition, applied as well as fundamental, will help workers throughout the world in promoting long health and long life.

As I mentioned earlier, a constructive approach requires that we strive to attain, and to maintain, optimum health while repairing damage. The aged who play golf and conduct thriving businesses may yet need special nutritional attention. Scientific assessment of the nutritional needs of the aged is hampered by lack of age-weighted standards. Also contributing to confusion on this point is the apparently wide variation in requirements from one older person to another. Nevertheless, we know that the diets of the aged are often inadequate, sometimes as a result of habits acquired in the days when malnutrition caused such diseases as pellagra in many thousands of our people.

Fortunately, the population as a whole has lost much of its complacency concerning nutrition. In the aged, however, poor diets may result from psychological, social or mechanical difficulties. A too-familiar picture is that of the elderly widow alone in a light-housekeeping apartment with her hot plate and her milk of magnesia. Often she just will not bother to prepare a nutritious meal. Wide variations in diet occur among older people who live in institutions, hotels, large rooming houses, or quasi-households of that type. This comprises about 1 in 23 Americans aged 65-and-over *(22)*.

About four-fifths of this age group live with relatives. At the family table, the aged may be handicapped by dental and digestive difficulties, and even their status within the family may affect their diet. For the most part, however, our aging population is receiving some of the benefits of nutritional advances. Food technology in particular has helped this majority, through food fortification, increased availability and palatability of foods, and other innovations. This is a major aspect of the public health approach through which we may hope to eliminate some day the need for specific nutritional therapy.

For the aged, as for all other groups, the most reliable way of ensuring a proper diet is through education. Ancel Keys, at the University of Minnesota, lists in a recent article thirteen points to be stressed for old people *(14)*. These emphasize a balanced diet and abundant fluid, the sparing use of fats and salt, the desirability of fortified products, and other rules of nutrition established in recent years. An important objective in educational programs is to maintain an omniverous diet—to keep the aging person from deciding that he can eat only certain foods.

Correction of dietary patterns in the aged is no simple matter. The habits of a lifetime are not easily changed, and moreover, their modification must be approached with caution. The human body is remarkably adaptable, and inherent abnormalities of digestion and metabolism may have led to compensatory dietary practices. Unfortunately, the contrary is frequently the case. Our selection and consumption of food often obeys a misleading appetite, and the result may be damage and disease. Wisdom, tact and patience are requisite to the maintenance of good nutrition in the aged, and must be applied in all educational programs, whether the physician, nutritionist, or a public advertisement conveys the information.

Nutrition science is only beginning its venture into gerontology and the major chronic diseases. Whether we make substantial contributions in the near future depends largely on the cooperative efforts of many individuals and groups. No longer is scientific progress by lone investigators the rule, as in the days of Pasteur and Ehrlich: various disciplines must coordinate their attack. Your Institute of Food Technologists, for example, is playing a major part in converting nutrition theory to food therapy, nutrition knowledge to public health gains.

This meeting today, with its varied and eminent representation, is every evidence of the spirit needed for success. And I am confident that we will continue to meet our deep responsibility for the health of the people, whether they number 160 million, or 15 million more than that in another decade, and whether they are young or aging.

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Flow Sheets of Prepackaged Fresh Meats[a]

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Microbial counts were made of the environmental surfaces of a retail meat prepackaging unit. Counts were also made on prepackaged beef, lamb and pork after periods of display in a self-service meat case.

Many meat retailers have converted to the prepackaged self service style of handling meats since 1942. The growth in numbers of stores offering this service has been rapid. Teitelman *(6)* reports that as of April 1, 1948, there were 178 stores with 100% self service as compared with between 2,700 and 2,800 *(2)* stores as of January 1, 1951. Many other retailers are now considering a similar change.

If this type of merchandising is to be adopted, there are many problems to be investigated. Since 1946 there have been numerous studies on prepackaged meat. In most cases these studies have been of a popular vein dealing with consumer opinion and retailer questionnaires. There have been no reported studies made from the bacteriological viewpoint in preparing prepackaged fresh meat for the customer.

Under this retailing method removal of bone dust, traying, holding for color development and packaging are additional work steps. Equipment not ordinarily used in the old style of meat merchandising—such as trays, backing boards, labels, and films—are used in preparing the product. Additional handling of the product and more equipment with which the product comes in contact undoubtedly increase the initial microbial count of the meat. In prepackaged fresh meat more units of one particular retail cut are made at one time than in the old type of meat merchandising and are displayed for a longer period of time.

For these reasons, the authors in their studies divided this problem into two sections:

(a) Determination of the number of bacteria found on the equipment and on the environmental surfaces where the meat was packaged.

(b) Determination of the microbial counts of the meat as displayed in cooperating commercial markets over a period of 5 days after being cut and packaged in these markets.

EXPERIMENTAL PROCEDURE, PART I

Cut-outs of different shapes but equalling 1 sq. in. were made in a 3½" x 5" piece of sheet metal as prescribed by Jensen *(4)* for use in this study. These cut outs were sterilized before each use by wiping with alcohol and flaming until dry.

During the time the cooperating markets were at work, bacteriological examinations of equipment and environmental surfaces were made. Trays, walls, saw blades, knives, scales, boning blocks and other equipment were sampled by using sterile cotton swabs. Swabs were taken by thoroughly rubbing the area exposed through the opening of the sheet metal frame. These were then placed in dilution blanks containing 99 ml. portions of sterile saline solution. They were then shaken until the cotton was well fluffed. Samples of the solution were removed and plated on T. G. E. agar. Incubation was at room temperature, 20° C. (68° F.), with counts made at the end of 48, 72 and 120 hours. The number of organisms counted represented organisms per square inch of surfaces sampled. The counts obtained after 120 hours of incubation are shown in Table 1.

EXPERIMENTAL PROCEDURE, PART II

The beef, pork, and lamb used for this study, in all cases except one, were from animals killed in the Michigan State College meats laboratory. The animals were dressed in the usual way and chilled at 1° C. (34° F.) for at least 48 hours in the meats laboratory cooler. Portions of the carcasses were taken to 2 local cooperating markets offering the prepackaged style of meat merchandising. The wholesale cuts were converted into retail units in the cooperating markets. All retail

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TABLE 1

Swab samples of equipment

	Store 1 Trial 1 Bact./Sq. Inch	Store 1 Trial 2 Bact./Sq. Inch	Store 2 Trial 1 Bact./Sq. Inch
Tray	300	740	880
Tray	100	2,960	690
Cutting Room Wall	130	480	380
Cutting Room Wall	50	400	330
Cutting Room Wall	200	210	310
Cooler Wall	200	180	110
Cooler Wall	100	640	670
Cooler Wall	260	220	1,170
Band Saw Blade	212,000		610
Band Saw Platform	3,700		169,000
Meat Slicer Blade	2,100	1,290	361,000
Meat Slicer Platform	2,600	330	1,390
Steak Knife	970	1,080	32,100
Steak Knife		480	17,600
Packaging Table Top	1,100	410	1,850
Hand Saw Blade		8,800	1,380
Cleaver		84,000	1,990
Scale	620	1,170	390
Boning Block	7,190,000	12,400,000	6,400,000
Hamburger Chute	2,800		80,000

cuts used in this study were of the steak or chop variety, ¾" in thickness.

All portions of meat with bone in them were cut on the bandsaw. The bone dust was removed by use of a piece of spring steel attached to a wooden handle.

The cutting, scraping, and placing of the meat upon a papered stainless steel tray was done in the cutting and packaging room of the cooperating stores at a temperature which varied from 10°-16.6° C. (50°-62° F.). The trays of meat were then taken into the cooler for a period of 20-30 minutes for color development before packaging. The cooler temperature varied from 55°-2.2° C. (33°-36° F.). The average time required from the start of the cutting operation until the meat was returned to the cooler was 25-30 minutes.

After this holding period the meat was returned to the cutting and packaging room. Samples to be used for bacteriological determination were taken from 5 or more pieces of the meat designated as pre-display samples. The remaining pieces of meat were packaged for display in the self service case 1°-3.3° C. (34°-38° F.) for a period of 5 days. These cases were the same as reported upon by Gowland *(3)*.

Rodeo Backing Boards and 300 MSAT No. 80 cellophane were used in packaging. The packages were sealed on the backing board surface with a hand sealing iron.

Five or more packages were removed after each 24 hrs. display period. Maximum display time was 120 hours, or 5 days.

The samples were taken aseptically by means of a sterile cork borer with an area of 1 sq. in. Cores so removed represented 2 sq. in. of exposed surface in addition to ¾ inches of intra-surface tissue. In determining the bacteriological count of each sample of meat, the counts obtained were considered to be the counts of organisms found on the 2 sq. in. surface of the meat. In this investigation surface organisms were not segregated from those found within the meat. These, as shown by Mallmann *(5)*, are negligible when working with such large numbers of bacteria as are found on meat.

Ninety-nine ml. of sterile physiological saline solution was placed in a sterile Waring Blendor jar. After running one minute, an initial plating was made of this solution as a check against any possible contamination. The meat sample was then added and allowed to run 3 or 4 minutes until the sample was completely macerated. Pour plates were made using T. G. E. agar as the media. These were allowed to stand at room temperature 20° C. (68° F.) for 48 hours before counting. They were again counted after 72 hours and after 120 hours of incubation.

In analyzing the data, the 72-hour incubation counts were used exclusively. These counts were converted to logarithms, added, and then divided by the number of samples to obtain the geometric mean. The antilogarithm of the geometric mean was determined.

To present the data graphically, the following method was used: the graphs are based upon the antilogs of the geometric means for the incubation counts of the samples for successive display periods. The antilog of the geometric mean obtained for the pre-display samples was divided into the incubation count of successive display periods to obtain the amount of increase or decrease for that display period. This increase or decrease was graphed. The geometric mean of the pre-display samples was given the value of 1. To demonstrate, Figure 1 is as follows:

	Antilog of geometric mean	Amount of increase	Relative position
Pre-display Samples	16,800	1	2.54
24 Hour Display Samples	23,100	1.38	
48 Hour Display Samples	28,000	1.67	
72 Hour Display Samples	43,900	2.61	
96 Hour Display Samples	67,500	4.02	
120 Hour Display Samples	151,000	8.99	

To show the relative position of one trial with another, the lowest antilog of the geometric mean for pre-display samples of all trials was divided into the antilogs of the geometric means of pre-display samples obtained for all other trials.

To demonstrate the relative position of one combined trial to another, the following method was used: The lowest antilog of the geometric mean for the pre-display samples obtained was 6,620 for pork, Trial 1. To find the relative position of the combined trials of pork, 6,620 was divided into 16,800 (antilog of the geometric mean for pre-display samples of combined pork trials). The result was 2.54, therefore, the starting point for the combined trials of pork is 2.54.

Store trials by kinds of meat were combined and are shown in Figures 1, 2, and 3. The incubation count geometric means of the trials were added. The antilog of the mean of the geometric means was obtained. The relative increase of display period was found and shown graphically. Starting position is relative to pork, Trial 1 (6,620).

RESULTS

Environmental surface contamination as found in the cooperating markets is presented in Table 1. These data are for a 120-hour incubation count. It should be noted that all surfaces sampled, except those dealing directly with the cutting operation, were low in number

Pre-Display Count Base 1	= 6,620 (Pork, Trial 1)
Pre-Display Sample Count	16,800
24 Hour Display Count	23,100
48 Hour Display Count	28,000
72 Hour Display Count	43,900
96 Hour Display Count	67,500
120 Hour Display Count	151,000
	Display Count
Display Period Points	16,800

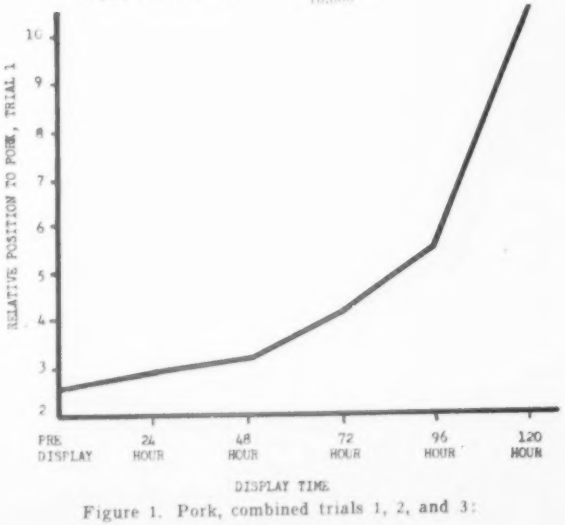

Figure 1. Pork, combined trials 1, 2, and 3:

Pre-Display Count Base 1 =	6,620 (Pork, Trial 1)
Pre-Display Sample Count	232,000
24 Hour Display Count	295,000
48 Hour Display Count	386,000
72 Hour Display Count	476,000
96 Hour Display Count	681,000
120 Hour Display Count	1,350,000
Display Period Points	Display Count 232,000

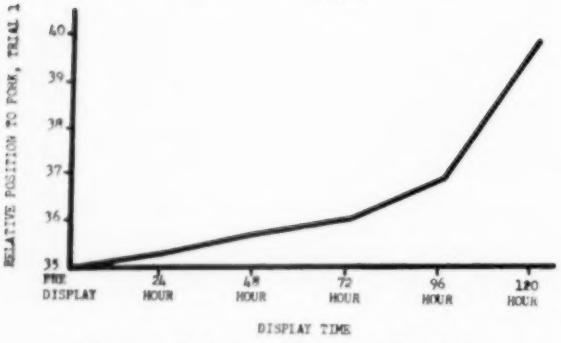

Figure 2. Beef, combined trials 1, 2, and 3:

of organisms. Knives, saws, and the boning blocks used for cutting the meat were found to offer the greatest source of contamination to prepackaged fresh meat.

Part two of the study discloses a wide range in numbers of organisms present in prepackaged fresh meat. The collection of representative quantitative samples of the microörganisms on the meat is extremely difficult due to the variability of contamination. Considerable variation in bacterial counts must be expected.

Of the 3 meats used in the study, pork was found to have the lowest number of microörganisms. Some inconsistencies in the slope of the lines were noted when individual trials were compared. A more accurate concept of growth trends is obtained when the trials are combined. The first 2 days' display time may be considered the lag or initial phase as described by Buchanan *(1)*, during which time the number of organisms remains nearly constant. At the end of this period the graphs indicate that the organisms have entered the positive growth acceleration phase, during which the average rate of increase in numbers increases with time.

Pork used in this study appeared to be in good salable condition even at the end of 5 days. This would indicate that the appearance of the meat is not an indication of its bacterial content, as at the end of 5 days the microörganisms were well into the positive growth acceleration phase.

The importance of these growth curves may be pointed out in that meat retailers use color and general appearance as an indication of quality. So long as the appearance is satisfactory the product is considered salable. At the end of 5 days' display time, the pork appeared to be in a good salable condition but the number of organisms was well into the positive growth acceleration phase. Suppose a patron purchased a package of pork that had been displayed 5 days and then held the package in the home refrigerator an additional 5 or 6 days. One can hardly imagine the number of microörganisms it would contain after this length of time.

Pre-Display Count Base 1 =	6,620 (Pork, Trial 1)
Pre-Display Sample Count	223,000
24 Hour Display Count	420,000
48 Hour Display Count	528,000
72 Hour Display Count	813,000
96 Hour Display Count	2,280,000
120 Hour Display Count	6,640,000
Display Period Points	Display Count 223,000

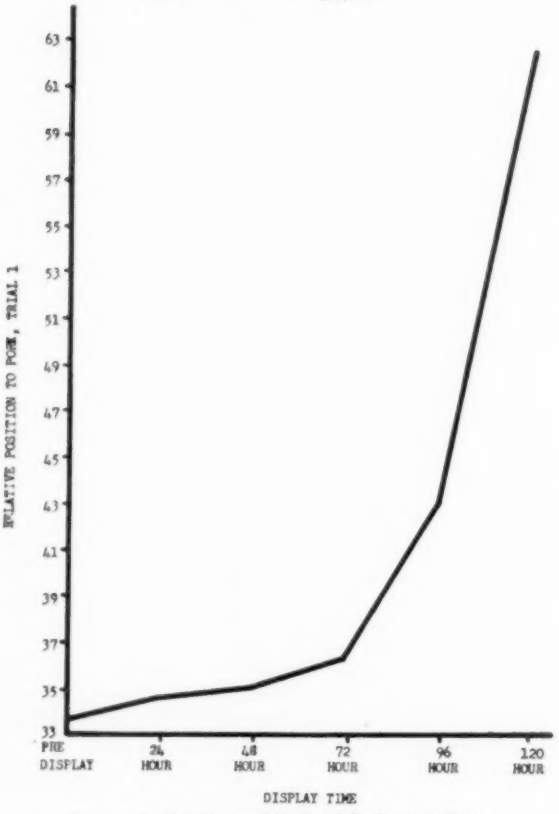

Figure 3. Lamb, combined trials 1, 2, and 3:

The beef used in this study would indicate essentially the same results as those found with pork. The initial counts were higher than those found in pork. The combined curve of the 3 trials for beef indicates that it took 3 days of display time for the initial number of organisms to double in number. After 4 days the count indicates that the numbers had redoubled in 24 hours, while the count at the end of 5 days indicates that the numbers had increased nearly three-fold. After 5 days of display, the appearance of the beef cuts was variable. Some were considered salable and others were not.

Results with lamb indicated that the initial phase varied between 2 and 3 days. With lamb, growth was more rapid during the acceleration phase than with pork or beef. After displaying for 2 or 3 days, the lamb appeared to be dark colored, dehydrated, and generally not salable. Wiesman *(7)* recommends that lamb should be kept at a lower temperature than pork or beef. This procedure may lengthen the initial phase and retard the rapid growth of the acceleration phase.

The slope of the combined trial curve gives the same results as pork and beef except in the faster rate of increase for the positive growth acceleration phase.

CONCLUSIONS

Equipment concerned directly with the cutting operation offers the greatest source of contamination for prepackaged fresh meat in the retail store. During the first 3 days of display time, the increase in numbers of organisms on prepackaged fresh meat is small. After 3 days of display time the number of microörganisms found on prepackaged fresh meat is greatly increased.

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Sampling Procedure for Grading Tomatoes[a,b]

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A sampling procedure for grading tomatoes is described. The procedure is applicable to tomatoes and other products packed in baskets, boxes, crates, cartons, etc. Ten tomatoes from ten baskets (or a multiple thereof depending on the desired precision) is shown to be an efficient method for obtaining a 100-tomato sample for grading purposes.

In the usual practice of grading of raw tomatoes for processing, 2 to 4 hampers are removed from the load in some random fashion, and the entire contents of perhaps 200 to 600 individual tomatoes are used for determining the grade of the load. This procedure has met with considerable criticism, largely because these 2 to 4 baskets do not constitute an adequate sample on which to establish the grade. For example, in a study carried out at the Crosse & Blackwell Company in 1951, it was found that on the average a grade based on 2 baskets resulted in a standard error of 4.6% and that 12 baskets would be required for the error in the grade to be reduced to 2%. Similarly, studies in California revealed that 10 boxes or more should be used in order to obtain a reasonably accurate sample from a load of tomatoes *(3)*.

It is obvious, however, that sampling 10 or 12 entire baskets containing well over 1000 individual fruits is entirely impractical under actual grading conditions. There remains the possibility, however, that an adequate sample may be drawn from more than 2 to 4 baskets, but that only a fraction of the tomatoes in each basket be used for the actual grading. This study was undertaken in order to determine how many tomatoes out of how many baskets would comprise the most efficient sampling procedure.

MATERIALS AND METHODS

During the tomato processing season of 1952, 24 loads of tomatoes were sampled in accordance with the U. S. grades and for color by the use of the Hunter color-difference meter *(2)*. From each load, 7 types of samples were drawn in duplicate, for a total of 14 individual samplings, each consisting of 100 fruits. These 7 types of samples were obtained as follows: (a) 50 tomatoes from 2 baskets, (b) 33 tomatoes from 3 baskets, (c) 20 tomatoes from 5 baskets, (d) 10 tomatoes from 10 baskets, (e) 5 tomatoes from 20 baskets, (f) 2 tomatoes from 50 baskets, (g) 1 tomato from 100 baskets.

The samples were obtained at equal intervals as the trucks were unloaded. Thus for the smaller loads containing about 500 baskets, one tomato was drawn out of every fifth basket for sampling (g), and additional 2 fruits out of every tenth basket for sampling (f), etc. Each basket from which a sample was removed was first laid on its side, and the sample taken in a random manner without the operator actually looking at the individual fruits obtained.

Each of the 14 samples containing 100 fruits was collected in one basket and submitted to an official U. S. grader who provided a U. S. grade in duplicate in accordance with the routine procedure. A single value in terms of % U. S. No. 1 equivalent was obtained in the following manner: (% U. S. No. 1 × 1) + (% U. S. No. 2 × 0.5) + (U. S. Culls × 0.0) = U. S. No. 1 equivalent *(4)*. Average U. S. grades for these 24 loads ranged from 56 to 88 U. S. No. 1 equivalent. There was no significant correlation between the average U. S. grade and the variability encountered. The same sample was then collected, juiced in a miniature laboratory pulper-finisher, centrifuged to eliminate the larger air particles, and placed on the Hunter color-difference meter where the "L," "a," and "b" values were determined in duplicate. The color index was then determined in terms of U. S. color scores for processed tomato juice by reference to the nomograph presented previously *(2)*. Thus 28 individual determinations of the grade and of color were obtained for each of the 24 loads.

The errors in terms of standard deviations for each of the seven sampling procedures were determined by calculating the standard error of the difference between each individual determi-

[a] Scientific Publication No. 2433, Contribution No. A403 of the Maryland Agricultural Experiment Station (Department of Horticulture). Partial support from funds provided under the Research and Marketing Act of 1946, Project-NEM3.
[b] Presented at the Thirteenth Annual Meeting of the IFT, Boston, Massachusetts, June 22, 1953.

nation, and the average of the 28 determinations for each load, which was taken as the true value for the load.[e]

RESULTS AND DISCUSSION

This problem of how many tomatoes out of how many baskets will provide the most efficient sample is essentially similar to the problem of field plot size and shape, where the question is how many plants in how many rows will constitute the most efficient field plot *(1)*. The problem may therefore be solved in a similar manner. Fortunately, this tomato sampling problem is considerably simplified, since it may be assumed that there is no appreciable correlation between adjacent baskets in a load of tomatoes.

Since it may be assumed that the sampling error will be reduced as the number of baskets from which the 100 fruits are drawn is increased, and the cost will increase as more baskets need to be handled, the problem is to determine at what point does the increasing cost of handling additional baskets begin to outweigh the reduction in the sampling error.

The first step is to determine what the actual error is when the samples are obtained by the above 7 different methods. It was assumed that the average of the 28 individual determinations obtained for each load, was the true U. S. grade and color grade for the load. The standard error of the difference between each of the 7 sampling methods and this mean were then calculated.[e] The results are presented in Tables 1 and 2,

TABLE 1

Relative efficiency of different sampling methods for grading of raw tomatoes for processing (U. S. grades)

1	2	3	4	5	6
No. of baskets	Tomatoes per basket	(s) Standard error	Cost[d] (minutes of labor)	Number[e] of samplings for 3% error	Efficiency[f] index
2	50	6.8	12.0	5.2	62
3	33	6.0	12.5	4.0	50
5	20	5.4	13.5	3.2	43
10	10	4.6	16.0	2.3	37
20	5	4.1	21.0	1.9	40
50	2	3.6	36.0	1.4	50
100	1	3.5	61.0	1.3	79

[d] Cost estimated as follows: 11 minutes required to handle sample of 100 tomatoes, + 0.5 minutes to handle each basket.
[e] Calculated as $N = (s/3)^2$
[f] Calculated by multiplying columns 4 x 5.

column 3. When the number of baskets were correlated with these standard errors, the following correlations were obtained:

	U. S. Grade	Color Grade
number of baskets × s	—.699	—.767
log of number of baskets × s	—.949	—.950
log log of number of baskets × s	—.993	—.952

Hence, it was concluded that a curve of best fit between the number of baskets used in obtaining the 100 fruits, and the error of sampling, was a log log curve, shown in Figure 1.

[e] Estimates of error were also determined by calculating the standard error between duplicate samplings with essentially similar results; however, the best correlation with number of baskets was only —.903, as compared to —.993 in the method used.

TABLE 2

Relative efficiency of different sampling procedures for grading of raw tomatoes for processing. (Color scores based on Hunter C-d meter)

1	2	3	4	5	6
No. of baskets	Tomatoes per basket	(s) Standard error	Cost[g] (minutes of labor)	Number[h] of samplings for .5% error	Efficiency[i] index
2	50	1.10	12.0	4.8	58
3	33	1.01	12.5	4.1	51
5	20	0.94	13.5	3.5	47
10	10	0.86	16.0	2.9	46
20	5	0.81	21.0	2.6	55
50	2	0.75	36.0	2.3	83
100	1	0.72	61.0	2.1	128

[g] Cost estimated as follows: 11 minutes required to handle sample of 100 tomatoes, + 0.5 minutes for each basket.
[h] Calculated as N (number) $= (s/.5)^2$
[i] Calculated by multiplying columns 4 x 5.

Next an estimate was made of the cost, in terms of minutes of labor, involved in sampling and grading by the various methods. It was estimated that 11 minutes are required to grade a sample of 100 tomatoes. This includes for the U. S. grade, placing the sample on the grading table, examining each tomato and placing it into the proper bin, weighing, removing the sample, calculating the percentages and recording the results. For the color grade, it includes juicing the sample, withdrawing an aliquot, centrifuging, and obtaining and recording the 3 values on the Hunter color-difference meter.

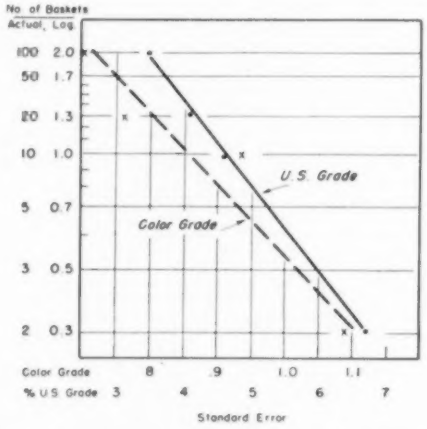

Figure 1. Relation of the standard error of sampling to the number of baskets from which the 100-fruit sample is obtained. (Log of the number of baskets plotted on semi-log scale.)

It was further estimated that a half minute is required to take each basket, place it on its side, and remove the proper number of tomatoes for the sample. Thus, where the 100 fruit sample is removed from two baskets, the total cost for sampling and grading would be 12 minutes, consisting of 11 minutes required for obtaining the grade plus one minute for handling 2 baskets. Where the 100 fruit sample is removed from 100 baskets, the total cost in time would be 61 minutes, consisting of 11 minutes required for obtaining the grade, plus 50 minutes required for handling 100 baskets. This cost in terms of minutes of labor is shown for the 7 different sampling methods in Tables 1 and 2, column 4. The increase in cost, and decrease in sampling error as

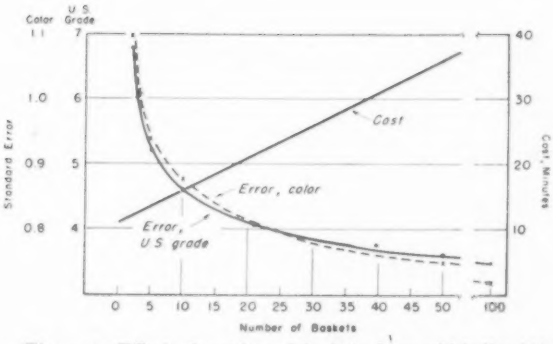

Figure 2. Effect of number of baskets from which the 100-fruit sample is obtained on the error, and cost of sampling.

the number of baskets from which the 100 fruit sample is removed is shown graphically in Figure 2.[1]

The next step is to reduce all the sampling methods to an equal error level. This may be accomplished by dividing each standard error (Table 1 and 2, column 3) by the square root of N, according to the following equation:

$$\frac{s}{\sqrt{N}} = P$$

Where s equals the standard deviation of the particular sampling method, N equals the number of times the test needs to be repeated in order to reduce the error to P. For example, in order to calculate how many times 100 tomatoes drawn from 2 baskets need to be repeated in order that the resultant error could be expected to be within 3% of the true mean, the equation may be set up as follows:

$$\frac{s}{\sqrt{N}} = P \text{ or } N = \left(\frac{s}{P}\right)^2$$

$$\text{Therefore } N = \left(\frac{6.8}{3.0}\right)^2 \text{or } N = 5.2$$

Now that we know the cost in minutes for each type of sampling, and the number of timees the procedure is to be replicated in order to obtain an equivalent degree of precision, all that remains to be done is to multiply the cost by N in order to obtain a relative efficiency index. These are shown for the various sampling methods in Tables 1 and 2, column 6, where it is apparent that sampling efficiency is improved as the number of baskets is increased until the number of 10 baskets is used. When more than 10 baskets are used, the efficiency index begins to go up again, thus indicating that 10 tomatoes from 10 baskets is the most efficient method of obtaining a 100-tomato sample for purposes of grading.

This procedure should be done at least in duplicate in order to reduce the U. S. Grade sampling error to approximately 3%; however, for a similar precision level, a procedure utilizing only 2 baskets would need to be replicated approximately 5 times.

[1] It is recognized that more time is required to remove 50 tomatoes than one tomato from a basket; however, it is anticipated that in such a procedure, some sampling equipment will be utilized when the entire basket contents will be placed in a hopper and the desired fraction obtained automatically *(4)*.

In comparing the present procedure of grading 2 or 3 entire baskets to the proposed method of using a multiple of 10 tomatoes out of 10 baskets, it may be calculated that a grade based on a determination of approximately 350 tomatoes from 3 to 4 baskets is equal in precision to a grade based on a determination of 100 tomatoes removed from 10 baskets. The number of fruits and baskets required for different degrees of precision by these 2 methods is shown in Table 3.

TABLE 3

Number of fruits and baskets required for obtaining different degrees of precision in the grading of raw tomatoes for processing

Precision as % error of U. S. grade	Tomatoes per basket	Number of baskets	Total number of fruits graded
1.0	all[a]	79	7936
	10	212	2116
2.0	all[a]	18	1849
	10	53	529
3.0	all[a]	8	822
	10	24	235
4.0	all[a]	5	462
	10	13	132
5.0	all[a]	3	296
	10	8	85

[a] Assuming 100 tomatoes per basket. The standard error for this sampling was estimated at 8.6 by extending the regression line in Figure 1.

It is asumed that in any sampling procedure that may be followed, there is equal opportunity for any tomato in any basket to be drawn. In other words, these results are based on random sampling. It is recognized, however, that conditions exist where routine grading must be accomplished before trucks are unloaded. In such cases, unless all baskets are removed from the top of the load (a very risky, and statistically unsound procedure), drawing the sample from 10 as compared to 3 baskets may prove to be more difficult than indicated in this study. On the other hand, where loads are not blended, and the grade need not be determined until the baskets are dumped, the best sampling procedure would be the automatic removal of a tomato at approximately regular intervals after the baskets are emptied.

SUMMARY

A procedure had been described for determining how many tomatoes out of how many baskets constitute the most efficient sample for grading purposes. The results indicate that 10 tomatoes out of ten baskets (or a multiple thereof, depending on the precision required) constitute the most economical sample. The same procedure is applicable to similar problems with other products packed in boxes, crates, cartons, etc., rather than in bulk.

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A Survey of Times and Temperatures in the Transportation, Storage and Distribution of Frozen Foods

A. M. MUNTER, C. H. BYRNE, AND K. G. DYKSTRA
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(Manuscript received March 21, 1953)

Temperatures and handling conditions in frozen food distribution channels from public warehouses to retail cabinets in three major markets have been surveyed. Air and product temperatures are presented for each phase of distribution.

Repeated testing has shown that samples of frozen foods purchased at the retail level show greater quality deterioration than samples known to have been stored at 0° F. since the time of packing. Although the industry is generally aware that frozen foods are not maintained at 0° F. during their storage life, information was lacking on the specific nature of the exposure. Dykstra *(1)* discussed the conditions prevailing in parts of the distribution system used in handling frozen foods and offered suggestions for improvement. Findings published in U.S.D.A. Marketing Research Report No. 18 *(2)* showed how conditions encountered in frozen food distribution systems could result in elevated product temperatures. In order to gain at least a partial view of the picture, distribution practices prevailing in two Eastern distribution areas and one Western distribution area, which together represent approximately 40% of the retail sales of a major frozen food packer, were surveyed. The surveys were conducted during July, August and October of 1952. During these months some of the most severe conditions prevailed. Principal objective of the survey was the accumulation of temperature and time data in existing distribution systems. A second objective was the observation and recording of general handling practices. The patterns in all three areas were essentially the same; therefore, all the data have been combined and the discussion which follows makes use of the combined values from all areas.

FIELD SURVEYS

Public refrigerated warehouses form the nuclei of the distribution system. It is here that frozen foods are stored for most of their life span, and it is from here that frozen foods are released to the retail trade. The next link in the chain is the order assembly room which may serve as a temporary storage room, and as the name indicates, a place for assembling orders for delivery to retail stores. Such rooms are also commonly known as breakup rooms. Deliveries are usually made in trucks with insulated bodies. They employ mechanical or dry ice refrigeration. The final link is the refrigerated cabinet in the retail outlet where frozen foods are displayed until sold to the consumer.

Data were collected in all of these phases by a survey team consisting of 3 experienced men. Air and product temperatures were determined in public warehouse storage rooms and order assembly rooms. Handling practices were observed. The survey workers accompanied delivery trucks and observed temperatures inside truck bodies. The temperatures of products delivered to the stores were also taken. Separate visits were made to stores selected at random and temperatures were recorded in all types of cabinets. This included both the self-service types and closed types. Temperatures were recorded in walk-in frozen food storage rooms in those stores which had them. The techniques employed in taking the temperatures are presented in Table 1.

TABLE 1
Temperature testing techniques

Distribution phase	Thermometer location for air temperature	Location of case for case temperature	Product temperature
Public warehouse room and assembly room	Front Center Rear	Front Center Rear	Package from same case as for case temperature
Retail delivery truck	Top, center of load		
Delivery to store		One case of vegetables One case orange juice	Package from same case as for case temperature
Retail cabinet	2" from top 2" from bottom		Top package vegetable Top can orange juice

Thermometer—all-metal dial type.

Measuring Air Temperature:
For Trucks and Cars—Open door and place thermometer on top of a case. Close door immediately. Allow 10 minutes before reading.
For all others—Place thermometers in positions indicated. Allow 10 minutes before reading.

Measuring Case Temperatures: Insert stem of thermometer through top flap opening so that the tip is about 1" off the bottom of the case. Allow 10 minutes before reading.

Measuring Product Temperatures: Always select a top corner package from case.
For Concentrated Orange Juice—Without removing can from case, puncture holes in side and center of lid. Insert thermometer in outside hole and allow to precool 30 sec. Then insert precooled thermometer in center opening and read after 30 seconds.
For Vegetables and Fruit—With drill, bore a hole about 1" from the end on the long narrow side, then another 2½" from the end (center of panel). Insert stem of thermometer in the first opening and allow to precool 30 sec. Then insert precooled thermometer in center opening and read after 1 minute.

ANALYSIS OF DATA

Data from each part of the distribution system have been combined for all 3 cities and are presented in Figures 1 through 11. The data were first assembled for each phase as is indicated in Table 2. The temperatures (column 1) were arranged in order of magnitude, starting with the lowest and proceeding to the highest. Column 2 indicates frequency of occurrence. Consecutive numbers were assigned to each temperature reading, and the number which fell at the midpoint of each temperature group was used as the m number. The probability of encountering a temperature equal to or less than the one indicated was calculated by the formula $\frac{m}{n+1} \times 100$, where n equals the total number of observations. The calculated values (column 4) were then plotted on normal probability paper. It was discovered that certain of the data formed a skewed distribution pattern rather than a normal one, and for these, skewed probability paper was used. A skewed distribution curve is the result of abnormal distribution of temperatures above and below the mean. In those instances where it occurred the temperatures deviated to a greater extent above the mean

TABLE 2
Air temperatures in 58 warehouse rooms in three cities

Temperature °F. (1)	Frequency (2)	*m* (3)	Probability (%) equal to or less than (4)
−18	1	1.0	1.7
−13	1	2.0	3.4
−10	1	3.0	5.1
− 9	4	5.5	9.3
− 8	8	11.5	19.5
− 7	2	16.5	28.0
− 6	2	18.5	31.3
− 4	4	21.5	36.5
− 3	3	25.0	42.4
− 2	2	27.5	46.6
− 1	1	29.0	49.2
0	5	32.0	54.2
+ 1	4	36.5	62.0
+ 2	7	42.0	71.1
+ 3	3	47.0	79.6
+ 4	3	50.0	84.7
+ 5	3	53.0	90.0
+ 9	2	55.5	94.0
+11	1	57.0	96.5
+12	1	58.0	98.2
	$n = 58$		

than below. A skewed curve is indicative of uncontrolled conditions in those particular phases in which it is observed.

The interpretation of the data in terms of specific temperatures and probabilities is readily available from Figures 1 through 11. For example from Figure 1, 50% of the warehouse room temperatures were *equal to or less than* −2° F. (−18.9° C.). Conversely 50% of the room temperatures were above −2° F. (−18.9° C.).

WAREHOUSES

Temperatures were observed in 58 rooms in 15 different warehouses in the 3 cities. No really serious elevated temperatures were found in any of the public warehouses. Temperatures ranged from −18° F. to 12° F. (−27.8° to −11.1° C.). Average temperature was −1.8° F. (−18.8° C.). One warehouse room was found to be −18° F. (−27.8° C.). Two warehouses registered temperatures at or above 10° F. (−12.2° C.). Product is in storage for periods varying from a few days to one year or more.

Because storage in these rooms is invariably in excess of a few days, the room temperatures are a good index of product or case temperatures. It is not considered necessary to observe product temperatures in these warehouses.

Although this is a favorable picture, it must be remembered that the time of exposure of frozen foods in public warehouses is long. Therefore, temperatures of storage considered only slightly above normal, may result in deterioration of quality. Unfortunately, all too little is known about many minor changes in quality in most frozen foods when held at temperatures in the range of 0° F. (−17.7° C.) to 10° F. (−12.2° C.) to 15° F. (−9.4° C.). The extent of deterioration, or damage, caused by such elevated temperatures is highly specific for the various frozen food products. For example, most frozen concentrated orange juices are highly sensitive substances, and will deteriorate badly in flavor and in ability to reconstitute properly if held for extended periods of time at temperatures of from 10° F. to 15° F. (−12.2° C. to −9.4° C.). Because of the variable and usually long time of exposure, frozen foods in public warehouses should be kept at temperatures of 0° F. (−17.8° C.) or below.

Incoming shipments were usually handled rapidly and efficiently. Observed shipments were unloaded and in the warehouse in the minimum time of 2 hours and a maximum time of

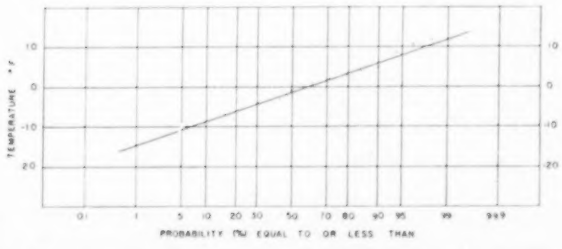

Figure 1. Probability of encountering various air temperatures in warehouse rooms based on triple determinations in 40 rooms in 15 different warehouses in three cities.

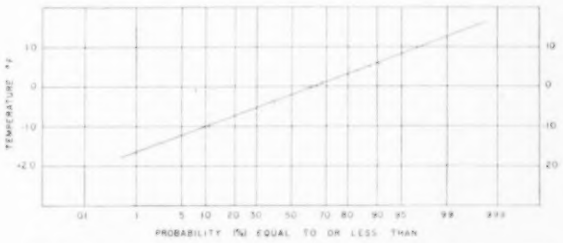

Figure 2. Probability of encountering various temperatures in frozen food cases stored in refrigerated warehouses based on 163 determinations in three cities.

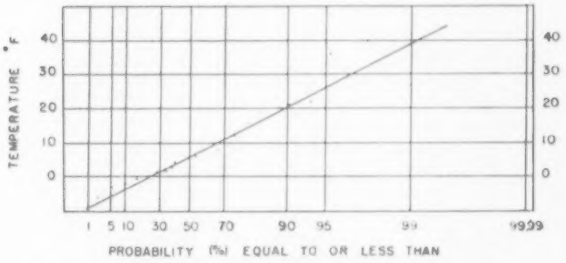

Figure 3. Probability of encountering various air temperatures in order assembly rooms based on triple determinations in 46 different rooms in three cities.

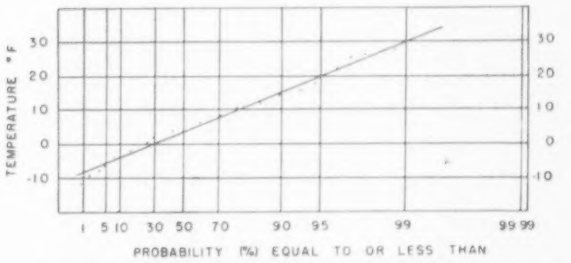

Figure 4. Probability of encountering various temperatures in frozen food cases stored in order assembly rooms based on 133 determinations in three cities.

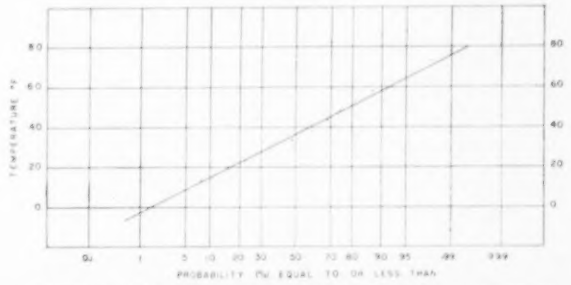

Figure 5. Probability of encountering various air temperatures inside frozen food retail delivery trucks based on 339 determinations made on 46 different delivery routes in three cities.

8 hours. The maximum time merchandise was found left unprotected on platforms was 1½ hours. This is too long for safety. Usually, however, this period was not more than 15 to 20 minutes. A period of one hour or more unprotected in the summertime will cause an appreciable rise in product temperature. Housekeeping was generally good. There was little evidence of the product being stacked against walls or being stacked without dunnage or pallets.

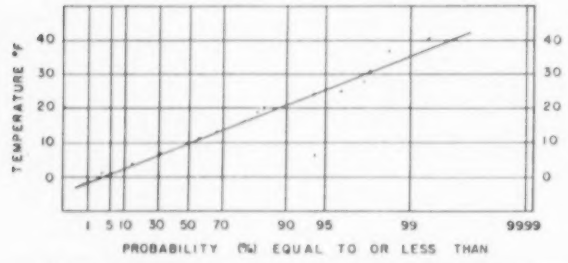

Figure 6. Probability of encountering various temperatures in frozen foods at the time of delivery to retail outlets based on 296 determinations in three cities.

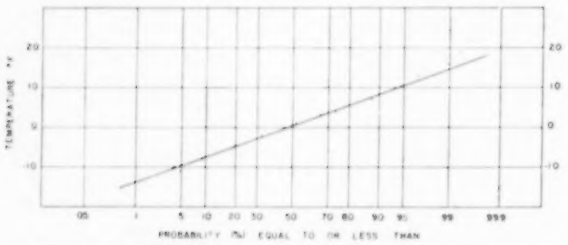

Figure 7. Probability of encountering various air temperatures at the bottom of retail frozen food cabinets based on single determinations in 332 different cabinets in three cities.

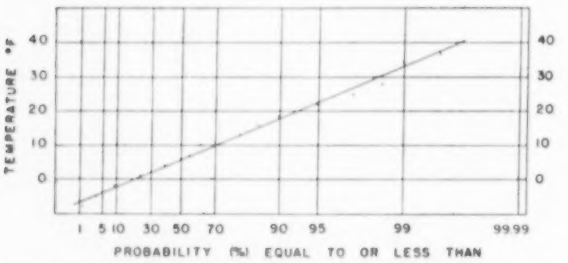

Figure 8. Probability of encountering various air temperatures two inches below the load line in retail frozen food cabinets based on single determinations in 332 different cabinets in three cities.

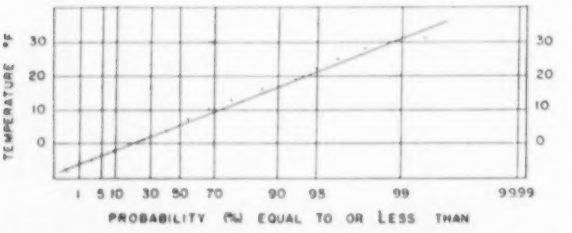

Figure 9. Probability of encountering various temperatures in frozen foods in retail cabinets. Single determinations were made on packages from the tops of stacks in 232 different cabinets in three cities.

ORDER ASSEMBLY ROOMS

Most public warehouses lease refrigerated space to wholesalers. These rooms, termed order assembly or breakup rooms, serve as temporary storage rooms as well as a place where merchandise is prepared for distribution to retail outlets. A small fraction of the merchandise is moved to outside assembly rooms. The practice of assembling orders on the premises of the public warehouses removes one extra hazard, and is therefore considered a desirable practice.

Temperatures in assembly rooms ranged from —6° F. (—21.1° C.) to as high as +40° F. (4.4° C.). Storage periods may range anywhere from one day to 10 weeks or more. However, maximum storage times usually do not exceed 2 weeks. In one severe condition, product was found stored for 15 to 20 days at temperatures in excess of 20° F. (—6.7° C.). In another instance the air temperature was 40° F. (4.4° C.), and product remained in this room for 24 hours. Fortunately those assembly rooms handling the majority of merchandise were held at temperatures below 10° F. (—12.2° C.).

Data on air and case temperatures found in 46 order assembly rooms are plotted on skewed probability paper in Figures 3 and 4. Skewed distribution in these instances is probably due to 2 factors.

(a) Not all operators attempt to hold assembly rooms at 0° F. (—17.8° C.).

(b) Mechanical facilities for holding the assembly rooms at the desired temperature are inadequate.

Good warehousing practices were not followed very well in any of the assembly rooms. It was not uncommon to find merchandise stacked on floors or next to walls and to find refrigeration coils badly covered with frost. The conclusion is that there is much room for improvement in order assembly room practices. Specific recommendations are:

(a) Use good frozen food warehousing practices in the assembly room.

(b) Keep the temperatures in the room at a minimum; preferably at or below +10° F. (—12.2° C.).

(c) Keep the time of product exposure in the assembly room at a minimum. Do not use these rooms as storage rooms.

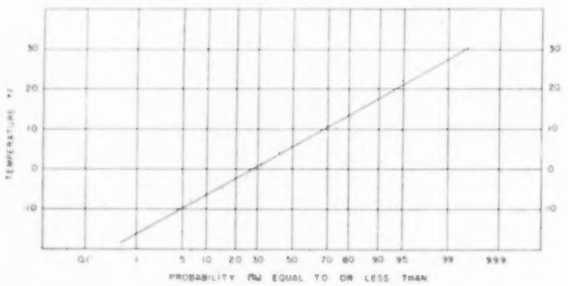

Figure 10. Probability of encountering various air temperatures in retail store walk-in storage rooms based on single determinations in 60 different rooms in three cities.

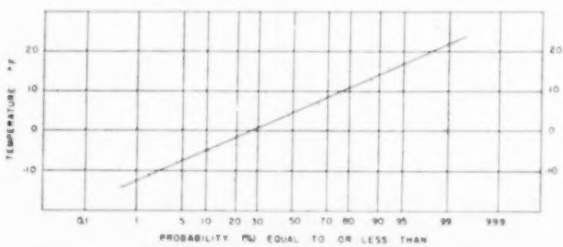

Figure 11. Probability of encountering various temperatures in frozen food cases stored in retail store walk-in rooms based on single determinations in 57 different rooms in three cities.

RETAIL DELIVERY TRUCKS

In this phase of the study, conditions were found which were good, fair and poor. The surveyors accompanied 46 trucks enroute on normal delivery runs. Approximately one-half of these depended solely on dry ice for refrigeration. The remainder of the trucks were equipped with hold-over plates.

Dry ice, when used in adequate amounts, produced fairly good results. All too often insufficient quantities were used. Loading the evening before for delivery the next day was a general practice. It usually resulted in higher product temperatures, particularly when truck bodies were not precooled. Performance of "hold-over plate" type refrigerated trucks was slightly superior to those employing dry ice. This is due largely to the automatic carry-over to the next loading of lower air temperatures in the truck bodies. A few trucks used dry ice to supplement holdover plates. These trucks gave the best overall performance.

Air temperatures in truck bodies were taken at approximately one-hour intervals throughout the delivery periods. These temperatures (Figure 5) follow a normal distribution pattern with the average at 36° F. (2.2° C.).

Temperatures of products when delivered to the stores (Figure 6) do not reach the high levels found in the trucks since exposure times usually never exceeded 24 hours. However, temperatures in some truck bodies were at too high a level for time intervals sufficient to result in product temperatures at delivery as high as 58° F. (14.4° C.). These extreme temperatures cause a skewed distribution curve. The temperature of products loaded into the trucks also has a marked effect on the product temperature at delivery since most trucks at best are designed to hold rather than to lower product temperatures. Product left in the delivery truck during repeated deliveries has a much greater opportunity to reach the temperature inside the truck. This practice is not recommended.

RETAIL CABINETS

Air temperatures at the bottom and top of 332 retail cabinets were determined. The data are shown in Figures 7 and 8. An analysis of these data indicates that the bottom temperatures followed a normal distribution pattern with an average of 0.4° F. (—17.4° C.). The top temperatures taken 2 inches below the indicated load line followed a skewed distribution pattern with an average of 6.9° F. (—14.8° C.). The maximum temperature encountered at this point was 37° F. (2.8° C.). Conditions which allow frozen foods to be exposed to such temperatures for extended periods are considered dangerous.

Temperatures of products from 232 different store cabinets were determined. This included both vegetables and concentrates. The data assume a skewed distribution pattern almost identical to that for air temperaures at the top of the cabinets where the majority of samples were taken. Figures 8 and 9 show this similarity.

FROZEN FOOD WALK-IN STORAGES AT RETAIL LEVEL

Distribution of temperatures from 60 walk-in storage rooms are presented in Figures 10 and 11. Values for air temperatures in these rooms ranged from —11° F. to 37° F. (—23.9° C. to 2.8° C.). The average was 5.5° F. (—14.7° C.). Both air and case temperature data fit normal distribution patterns. The walk-in rooms show about the same need for better housekeeping and lower temperatures as do order assembly rooms.

SUMMARY

To reassemble the overall distribution picture, Figure 12 is provided. This shows in graphic form the maximum air exposure temperatures to be expected at 6 selected probability levels in a frozen food distribution system. Figure 13 shows in a similar manner the maximum product temperature expected in each of the various phases. The time scale for these 2 charts is an approximation of normal handling. In most phases of distribution the product temperatures very closely approach the air exposure temperatures. The one exception is the temperature of products at delivery as compared to delivery truck temperatures where the difference is quite largely due to the relatively short exposure normally encountered.

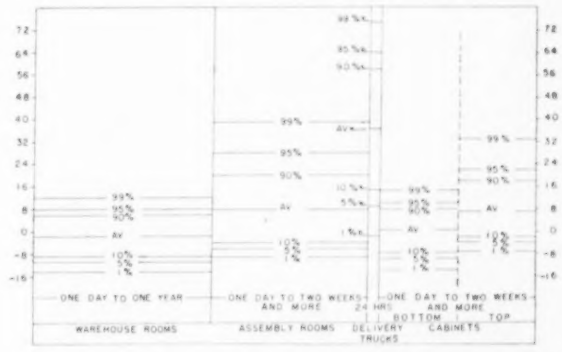

Figure 12. Maximum air exposure temperatures to be expected at six selected probability levels in warehouses, order assembly rooms, retail delivery trucks and retail cabinets based on observations made in three cities during July, August and October.

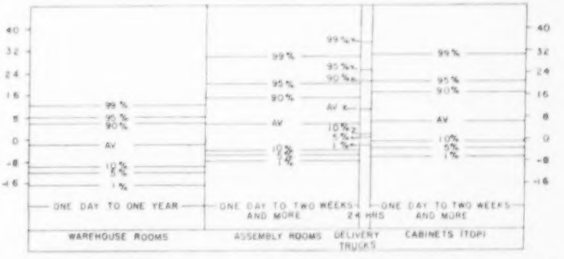

Figure 13. Maximum product temperatures to be expected at six selected probability levels based on determinations made on samples drawn from 40 rooms in 15 refrigerated warehouses, 46 order assembly rooms, 296 cases upon delivery to retail stores and 232 retail cabinets.

In any phase of the distribution system where skewed distribution of values resulted, the implication is that uncontrolled external factors are working against inadequate refrigeration facilities to a greater or lesser extent. It is in these phases where the greatest possibility of detriment to product exists. This situation prevails in order assembly rooms and at the top level in store cabinets. Retail delivery truck temperatures, while normally distributed, but at too high a general level, were directly responsible for a skewed product temperature distribution pattern at point of delivery. It is in these 3 areas where better control of temperatures should be exercised.

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1. Dykstra, K. G. Distribution practices in the frozen food industry. *Canner*, 114 (11) 16 (1952).
2. U. S. Dept. Agr. Marketing Res. Rept. No. 18. *Planning a Wholesale Frozen Food Distribution Plant.* (1952).

Distribution of Pectinesterase and Total Pectin in Component Parts of Citrus Fruits[a,b]

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(Manuscript received April 28, 1953)

Pectinesterase activity and total pectin expressed as calcium pectate are reported on wet tissue and dry solid basis for six component parts of seven varieties of mature citrus fruits. Data are also presented to show the Brix/acid ratio in the juice of the varieties selected and the amount of moisture in each component part.

A knowledge of pectinesterase activity and quantity of pectic material in the component parts of citrus fruits is significant to the citrus processor in evaluating the type of component parts to avoid in preparing the extracted juice. Since some of these component parts comprise the pulp content of frozen citrus concentrates, the gelation and clarification problem would be better understood if more were known about the distribution of the pectic substances and pectic enzymes.

The scientific literature is limited concerning information on the distribution of pectinesterase in citrus fruits, but is more voluminous on pectin content of albedo, rag, and juice of citrus. MacDonnell, Jansen, and Lineweaver *(3)* have stated that this enzyme is associated with the solid particles of citrus tissue and they have shown the pectinesterase activity in flavedo, albedo, and cell sacs of orange, lemon, and grapefruit, which had been salt extracted at pH 8.0 with 0.3M. sodium acetate. The results reported by them showed that in all cases the flavedo contained a higher activity per gram of wet weight than did the albedo or cell sacs, whereas the filtered juice contained no activity.

Rouse *(7)* has reported on the relationship of pectinesterase activity in Valencia orange juice with water-insoluble solids and with increased pulp content.

Myers and Baker *(4, 5)* reported on the extraction of lemon albedo at varying pH, temperature, and processing time in order to obtain highest jelly units for the commercial pectin manufacturer. Poore *(6)* has shown the amount of pectin as calcium pectate found in grapefruit peel and rag. From a maturity study Gaddum *(2)* has presented the yield of pectin, extracted as alcohol precipitates, obtained from albedo, pulp, and juice of Valencia oranges along with the purity of the alcohol precipitates as pectic acid. More recently, Sinclair and Crandell *(9)* have reported on the water-soluble and acid-soluble pectins as calcium pectate found in the vesicles and pulp of Valencia and Navel oranges.

The purpose of this study was to determine quantitatively the distribution of pectinesterase activity and total pectin in 6 component parts of the following citrus fruit: Dancy tangerine; Hamlin, Pineapple, Temple, and Valencia oranges; Marsh Seedless and Duncan grapefruit. The component parts consisted of flavedo, albedo, rag, juice sacs, seeds, and juice.

EXPERIMENTAL PROCEDURE

Preparation of samples. The component parts of 7 varieties of citrus fruits were carefully separated by hand from sound mature fruit. Twelve fruit were selected for the tangerine and orange varieties, whereas 6 were used for the grapefruit varieties. The flavedo, albedo, rag, and seeds were each ground through a food chopper so that composite samples could be secured. The whole juice sacs (cell sacs and juice) were comminuted in an Osterizer to rupture the sacs and liberate the juice which was separated by centrifugation in a Size 1, Type S-B International Centrifuge at a relative centrifugal force (R. C. F.) of 1,100. The juice was decanted and again separated by centrifugation. In this manner the sacs were separated from the juice and no further clarification of the juice was made. Samples of the component parts were taken for moisture determination.

To 60 g. of a component part, except for the juice, were added 150 g. of 2% sodium chloride solution, which was sufficient to cover the sample, and the mixture comminuted for 3 minutes in an Osterizer to further size the component particles. The slurry was finally sized by passing through an Eppenbach colloid mill with a clearance setting of 0.01 inch. Samples ranging from 2 to 5 g. depending upon the enzyme activity were weighed out and assayed for pectinesterase. The remainder of the slurry and the centrifuged juice were weighed and added to 2 volumes of 99% isopropyl alcohol. These preparations were allowed to stand overnight, then filtered, washed 3 successive times with 70% isopropyl alcohol, 2 successive times with the 99% alcohol, and finally dried in a vacuum oven for 15 hours at 70° C. (158° F.). Pectin extractions were made from the alcohol insoluble solids (A. I. S.) of the various component parts.

Methods of analyses. The method used for the measurement of pectinesterase activity in the component parts of citrus fruit was essentially that of MacDonnell, Jansen, and Lineweaver *(3)* as modified by Rouse and Atkins *(8)*. During the reaction period a pH 7.5 was maintained. The activities are expressed by the symbol (PE.u.)g. which represents the milliequivalents of ester hydrolyzed per minute per gram of wet tissue and/or dry solids. For easy interpretation the pectinesterase units are multiplied by 10^3.

Moisture content was determined for each component part before the addition of sodium chloride by removing excess water in an air drying oven at 80° C. (176° F.) for 2 hours and finally drying at 70° C. (158° F.) in a vacuum oven for 12 hours.

Total pectins were extracted from the A. I. S. of each component part by placing 2 g. of the material in a 250 ml. centrifuge bottle and adding 200 ml. of boiling 0.4% sodium hexametaphosphate. The bottle with contents was submerged in a boiling water bath to the neck of the bottle, which kept the mixture at 97° C. (206.5° F.), and agitated for 30 minutes. The extract, which had a pH 5.8-6.4, was centrifuged at a R. C. F. of 1,100, the liquid decanted onto a Buchner funnel with gentle suction using Whatman No. 41 filter paper, and precipitated in 2 volumes of isopropyl alcohol. The residue remaining was then extracted with 200 ml. of boiling 0.02 N. hydrochloric

[a] Presented at the Thirteenth Annual Meeting of the IFT, Boston, Massachusetts, June 23, 1953.

[b] Cooperative research by the Florida Citrus Experiment Station and Florida Citrus Commission, aided by a grant from the American Can Company, Florida Agricultural Experiment Station Journal Series, No. 163.

CONSTITUTION AND BY-LAWS

INSTITUTE

OF

FOOD TECHNOLOGISTS

Amended to August 1953

CONSTITUTION

ARTICLE I

Name

The name or title by which this corporation shall be known in law shall be the Institute of Food Technologists, Inc.

ARTICLE II

Address of Institute

The executive office of the Institute shall be located in Chicago, Illinois. The Institute may have other offices within or without the State of Illinois, as the Council may from time to time determine.

ARTICLE III

Corporate Seal

The corporate seal shall be circular in form and shall have inscribed thereon the name of the association, the year of its incorporation, and the words: "Corporate Seal, State of Illinois."

ARTICLE IV

Objectives

The particular business and objectives of said corporation shall be a non-profit, professional educational association to promote the application of science and engineering to the production, processing, packaging, distribution, preparation, and utilization of foods; by stimulating investigations into technological problems arising therein, and providing a medium for promulgating and discussing the results of such investigations; by stimulating and providing means for the free interchange of technological information and ideas among food technologists; by promoting recognition of the role of food technologists in the technical direction of operations in these fields; all of these endeavors having the ultimate objective of providing better and adequate foods for mankind.

ARTICLE V

Definition of Food Technology

Food Technology may be defined as the application of science and engineering to the production, processing, packaging, distribution, preparation, and utilization of foods. Knowledge of food technology enables its possessor to solve technological problems in one or more of these fields by the application of one or more of the physical or biological sciences, or branches of engineering. It may involve problems in the development of products, processes or equipment; the selection of raw materials; the fundamental changes of composition or physical condition prior to, during, and subsequent to industrial processing; or the nutritional value and health safety of foods.

ARTICLE VI

Memberships

Section 1. *Classes of Members.* The Institute shall have three classes of members: Professional Members, Members, and Student Members. The Council shall determine the class of membership to which an individual is entitled. Wherever used in this Constitution, when referring to members of the Institute or classes of memberships, the words "member" or "membership" if not capitalized or otherwise qualified, shall mean members or memberships of all classes except Student.

Section 2. *Professional Members.* Any person who is ethically qualified, and who has had training and experience in food technology as defined in Article V, or any person who in the opinion of the Council is recognized as distinguished in the contributing sciences as they apply to foods, shall be eligible to be a Professional Member of the Institute. The minimum training which shall qualify a candidate for eligibility for Professional Member is, in general, graduation from a college, university, or similar institution in which he has majored in one or more of the sciences or branches of engineering associated with food technology. The minimum experience which shall qualify a candidate for eligibility for professional membership shall be three years experience in food technology. The Council may, at its discretion, waive any or all of the foregoing requirements in the case of a person who, through long experience has distinguished himself in the field of food technology.

Section 3. *Members.* Any ethically qualified person, active in special or limited aspects of food technology as defined in Article V, who is an administrator, director or executive under whose jurisdiction operations in food technology are conducted; or who is engaged in the dissemination of knowledge of food technology; or one whose work requires a general knowledge of the broad principles of food technology as it applies to the products, processes or equipment with which he or she is concerned; or one scientifically trained in and who has entered a career in food technology; shall be eligible to become a Member.

Section 4. *Student Members.* Any ethically qualified person who has never been a Professional Member or Member of the Institute, who is registered as a student in an educational institution with at least Junior (third year) standing, who is a candidate for a Bachelor's or higher degree in one or more of the sciences or branches of engineering associated with food technology, shall be eligible for membership as a Student Member. This classification shall be his status only until the end of the calendar year in which

he completes his schooling. When graduated and otherwise qualified as defined in Section 3 of this Article, a Student Member may, upon application, be elected to Membership.

Section 5. *Membership Privileges.* All classes of members shall enjoy the privileges of the Institute with the following exceptions:

a. Only Professional Members may hold the following offices or appointments:

(1) President
(2) President-Elect
(3) Councilor-at-Large
(4) Regional Section Councilor
(5) Regional Section Chairman
(6) Member of the Committee on Programs
(7) Member of the Committee on Qualifications
(8) Member of the Committee on Nominations

b. Only Professional Members may vote in National elections or on Institute matters.

c. Members may hold Regional Section offices other than Chairman or Regional Section Councilor, and may vote in Regional Section elections and on Regional Section matters.

d. Student Members are not eligible to hold office in or vote on Institute or Regional Section matters.

Section 6. *Membership Applications.* The Executive Secretary shall supply suitable application forms to persons who are seeking membership in the Institute. An applicant for membership shall be considered nominated when three members who know him personally or by general reputation have endorsed his application. An applicant for Student membership shall be considered nominated when one or more members who are members of the faculty of his educational institution have endorsed his application.

Section 7. *Dues.* Professional Members, Members, and Student Members shall pay such dues as may be determined by the Council.

Section 8. *Withdrawal of Membership.* Any type of membership shall terminate by death, voluntary withdrawal, or otherwise, in pursuance of this Constitution. The right of a member to vote, and all other rights, privileges and interests in the Institute, its rights, privileges, and property, shall cease upon termination of membership. Any member may, by giving written notice to the Executive Secreatry of such intention, withdraw from membership.

Section 9. *Termination of Membership.* For cause, any membership may be suspended or terminated. Sufficient cause for such suspension or termination of membership shall be violation of this Constitution or any agreement, rule, or practice properly adopted by the Institute, or failure to pay membership dues, or any other conduct prejudicial to the Institute. Such suspensions and terminations shall be by two-thirds vote of the entire membership of the Council, provided that, except in the case of suspension or termination for non-payment of membership dues, a statement of the charges shall have been mailed by registered post to the last recorded address of the member at least fifteen (15) days before final action is taken thereon. This statement shall be accompanied by a notice of the time and place of the meeting of the Council, at which time the charge shall be considered, and the member shall have the opportunity to appear in person, or by representative, and present any defense to such charges before action is taken thereon. Membership dues for any calendar year become due on the 1st day of that year. Any member whose dues are sixty (60) days past due shall be suspended and that member's subscription to the Journal terminated. Members suspended for non-payment of dues may be reinstated at any time upon payment of the current year's dues.

ARTICLE VII

Transaction of Business

Section 1. *Management.* The management of affairs, business and concerns of the Institute shall be vested in a Council, consisting of the President, the President-elect, the most recently retired President, the Treasurer, ten (10) elected Councilors-at-Large, and the duly elected representatives of the Regional Sections of the Institute, as provided herein.

Section 2. *Officers and Council.* The officers of the Institute shall be a President, a President-elect, a Treasurer, and an Executive Secretary. The President-elect and the ten Councilors-at-Large shall be elected as provided herein. The Treasurer and the Executive Secretary shall be appointed annually by the Council and shall be eligible for reappointment at the discretion of the Council. Elected officers and Councilors-at-Large shall not be eligible for re-election until the next election following the expiration of their term of office, except as provided in Article VIII, Section 4. The President-elect shall be elected annually for a term of one (1) year, following which term the President-elect shall succeed to the office of President for a term of one (1) year. Five (5) Councilors-at-Large shall be elected annually for a term of two (2) years. The terms of office of elected officers and Councilors-at-Large shall start at the close of the Annual Meeting of the Institute following the election, or in the absence of an Annual Meeting, then at the close of the annual meeting of the Council held in lieu thereof. They shall serve until their successors have been duly elected and installed.

Section 3. *Regional Section Representatives.* Each Regional Section shall be authorized to elect one (1) Councilor plus one (1) additional Councilor for each one hundred (100) members in excess of one hundred (100) members accredited to that Regional Section. Regional Section Councilors shall be considered elected to the Council of the Institute upon certification of such choice by the Secretary of the authorized Regional Section to the President and the Executive Secretary of the Institute. Only members residing within the prescribed area of a Regional Section shall be counted in determining Regional Section representation on the Council.

Section 4. *Meeting of the Council.* The regular annual meeting of the Council shall be held, without other

notice than this Section of the Constitution, at the same time and place as the Annual Meeting of the members of the Institute.

Section 5. *Special Meetings of the Council.* The President may, when he deems it necessary, or the Executive Secretary shall, at the request in writing of ten (10) members of the Council, issue a call for a special meeting of the Council, and only fifteen (15) days notice shall be required for such special meeting. In lieu of a special meeting the President may, from time to time, direct the Executive Secretary to submit to the Council questions to be decided by mail vote. Twenty (20) days after the mailing of such a question the Executive Secretary will transmit to the President the replies received from the members of the Council. Two-thirds of the Council shall constitute a quorum for such Council action.

Section 6. *Quorum.* At all meetings of the Council, a majority of the members of the Council shall constitute a quorum for the transaction of business; but less than a quorum may adjourn such meeting from time to time, without further notice, until a quorum is present, except as otherwise provided in this Constitution. Any action taken at a meeting of the Council at which a quorum is present, by a majority of the members of the Council constituting such quorum, shall be deemed to be the action of the Council, except in matters requiring a majority of the entire Council, or a prescribed percentage of the entire Council.

Section 7. *Executive Committee.* There shall be an Executive Committee of the Council, consisting of the President, the President-elect, the most recently retired President, the Treasurer, and five (5) members elected by the Council from among its own members, by such procedure as it may prescribe. The Executive Committee shall exercise for and on behalf of the Council all of the functions the Council may authorize by resolution. Five (5) members of the Executive Committee shall constitute a quorum for the transaction of business.

Section 8. *Council Vote.* Only elected or otherwise qualified members of the Council shall vote on questions brought before the Council. Officers or agents appointed by the Council and other persons invited by the Council may participate at Council meetings but shall have no vote.

ARTICLE VIII

Nomination and Election of Officers and Councilors-at-Large

Section 1. *Nomination of Officers and Councilors-at-Large.* The nominees for officers and Councilors-at-Large shall be selected by the Committee on Nominations. Not less than two nor more than three nominees shall be selected for each position to be filled. The selections will be made and certified to the Executive Secretary and the President at least four (4) months prior to the Annual Meeting of the Institute. Prior to certifying the results to the Executive Secretary and the President, the Chairman of the Nominating Committee will submit to each member of the Committee a tabulation of the voting showing how each member voted. These tabulations will be signed by each member and accompany the certification of the selections made to the Executive Secretary, who will retain them until the end of the next Annual Meeting, after which they may be destroyed.

Section 2. *Election of Officers and Councilors-at-Large.* At least three (3) months prior to the Annual Meeting the Executive Secretary shall mail to each member entitled to vote, a printed copy of an election ballot, carrying the names of the nominees selected by the Committee on Nominations. Accompanying the ballots shall be brief biographical sketches of the candidates, together with a mailing envelope and an inner envelope. Each member shall vote for only one (1) candidate to fill each vacancy. The marked ballots shall be placed in the inner envelopes and sealed. Neither the ballot nor the inner envelope shall be signed or otherwise identified by the voter. The inner envelope will then be placed in a second envelope, on which the voting member will inscribe his name and address in the space provided thereon. Election ballots to be considered must be received by the Executive Secretary not later than forty-five (45) days after original mailing by him. The Executive Secretary shall then verify the eligibility of the voter, remove the sealed ballots from the outer envelopes, and forward the sealed ballots of eligible voters to a Committee consisting of not less than three (3) nor more than five (5) tellers who shall have been appointed by the President. The tellers shall count the ballots, tabulate the results, and transmit certified copies of the tabulation to the President and Executive Secretary not less than thirty (30) days prior to the Annual Meeting. In the event of a tie between two or more candidates the results will be decided by a majority vote of the Council at the Annual Meeting. The President shall announce the results of the election in the next succeeding issue of the Journal and in person or by proxy at the Annual Meeting.

Section 3. *Eligibility of Candidates.* It is the responsibility of the Executive Secretary to insure that all persons whose names appear upon an election ballot are eligible under the provisions of this Constitution to hold the office for which they are candidates. In any case where the name of an ineligible person is submitted the Executive Secretary will call upon the Committee on Nominations to furnish the name of an eligible person.

Section 4. *Vacancies.* Any vacancy occurring in any elective office or among Councilors-at-Large shall, until the next annual election, be filled by the Council. Any person so elected to office or as Councilor-at-Large may be a candidate to succeed himself at the next annual election.

ARTICLE IX

Meetings

Section 1. *Annual Meetings.* The Annual Meeting of the members of the Institute for the presentation of papers and the transaction of business shall be held at such time and place as may be designated by the

Council. Notice of the time and place of such Annual Meeting shall be served by the Executive Secretary on each member of the Institute by mail or by publication in the Journal of the Institute not less than ten (10) nor more than forty (40) days prior to the meeting. If mailed, the notice shall be addressed to each member at his or her address as it appears on the membership records of the Institute. Should the Council decide that unusual conditions make it inadvisable to hold an Annual Meeting of the members of the Institute, then a meeting of the Council shall be held in lieu thereof.

Section 2. *Special Meetings.* Special Meetings of the Institute may be held at such time and place as may be designated in the notice of the meeting, and may be called at any time by a two-thirds vote of the entire membership of the Council. Notice of time, place and purpose of every special meeting shall be served by the Secretary by mail upon each member of the Institute not less than ten (10) nor more than forty (40) days prior to the meeting. The notice shall be addressed to each member at his or her address as it appears on the membership records of the Institute.

Section 3. *Quorum.* At each annual or special meeting of the Institute there shall be present at least five percent (5%) of the members entitled to vote, either in person or by proxy, in order to constitute a quorum for the transaction of business; but less than a quorum may adjourn such meeting until such time as a quorum is present.

ARTICLE X

Fiscal Procedure

The fiscal year of the Institute shall be fixed by the Council. The Council shall prepare an annual budget to be submitted to the members of the Institute or published in the Journal at least thirty (30) days prior to each Annual Meeting. Funds to meet this budget may be provided by members' dues or otherwise.

ARTICLE XI

Committees

Section 1. *Finance Committee.* The President-elect shall appoint a Finance Committee. The Finance Committee shall have such powers and duties as shall be assigned to it by resolution of the Council. The President of the Institute shall be an ex-officio member of the Finance Committee.

Section 2. *Committee on Qualifications.* The President-elect shall appoint a Committee on Qualifications. This Committee shall examine the applications of candidates for membership and accept or reject such applications. The Committee shall also determine the class of membership for which an applicant is accepted. The determinations of the Committee shall be subject to review by the Council at any time.

Section 3. *Committee on Programs.* The President-elect shall appoint a Committee on Programs. This Committee shall prepare the programs for the Annual Meeting. The President and the President-elect shall be ex-officio members of this committee.

Section 4. *Committee on Regional Sections.* The President-elect shall appoint a Committee on Regional Sections. This committee shall have authority to recommend the chartering of additional sections and fix the boundaries between sections. The action of this committee shall be subject to review by the Council at its next regular or special meeting.

Section 5. *Committee on Nominations.* The President-elect shall appoint a Committee on Nominations, consisting of the Chairmen of all active Regional Sections and five (5) members at large. The President-elect shall designate one member of the Committee as Chairman.

Section 6. *Other Committees.* The President or the President-elect may appoint such other committees as may be deemed desirable. Each committee shall have such duties as shall be assigned to it.

Section 7. *Committees Appointed by President-Elect.* All Committees appointed by the President- elect shall serve during his term as President, except that the Committee on Programs may also function during his term as President-elect for the purpose of formulating plans for the ensuing year.

ARTICLE XII

Officers

Section 1. *Officers.* The Institute shall have as Executive Officers a President, a President-elect, a Treasurer, an Executive Secretary, and such other officers as the Council may determine.

Section 2. *President.* The President shall preside at all meetings of the Institute, the Council, and the Executive Committee. He shall have power to call meetings of the Council and the Executive Committee. He shall perform other duties and exercise other powers as the Council shall from time to time delegate to him.

Section 3. *President-Elect.* In the absence of the President the President-elect shall perform all the duties and shall have all the powers normally conferred upon the President. During his term as President-elect he shall organize his committees and formulate plans for his term as President. The President-elect shall present to the Council at its Annual Meeting immediately preceding his induction into the office of the President, a list of names of the individuals who are to serve on the various committees required under the provisions of this Constitution. He shall perform such other duties and shall have such other authority as the Council may from time to time assign him.

Section 4. *Treasurer.* Subject to the power and duties conferred upon him by the Council, the Treasurer shall have supervision over the funds, securities, receipts and disbursements of the Institute. He shall cause all funds received by the Institute to be deposited in the name of the Institute in such bank or banks, trust company or trust companies, as the Council may designate. He shall cause to be entered regularly in the books

of the Institute to be kept for that purpose, full and accurate account of all monies received and paid by him on account of the Institute, and he shall submit a statement of his cash account at each Annual Meeting of the Council, and from time to time as required by them such information relative to the funds of the Institute as may be required. He shall, in general, perform all the duties incident to the office of Treasurer, and shall perform such other duties and have such other authority as from time to time may be assigned to him by the Council.

Section 5. *Executive Secretary.* The Executive Secretary shall keep the minutes of all meetings of the Institute, the Council, and the Executive Committee thereof, in books provided for that purpose. He shall keep a roll of the members of the Institute, and such other books of record and account as the Council may direct. He shall perform such other duties as may from time to time be determined by the Council. He shall be required to give bond for the faithful performance of his duties in such form and amount as the Council may determine.

Section 6. *Subordinate Officers and Agents.* The Council may appoint other subordinate officers or agents, each of whom shall hold office for such period, have such authority, and perform such duties as the Council may from time to time determine. The Council may delegate to any officer or agent the power to appoint any subordinate officer or agent and prescribe his respective authority and duty.

Section 7. *Compensation.* The employees or agents to be compensated and the extent of the compensation of such employees or agents shall be determined by the Council, unless otherwise provided for in this Constitution.

Section 8. *Resignation.* Any officer may resign at any time by giving written notice to the President or Executive Secretary. Any such resignation shall take effect upon its being accepted by the Council.

ARTICLE XIII

Contracts, Loans, Deposits, Checks, Drafts, Etc.

Section 1. *Contracts.* Except as otherwise provided in this Constitution, the Council may authorize any officer or officers, agent or agents, to enter into contracts, to execute or draw up any instruments on behalf of the Institute, and such authority may be general or confined to specific instances.

Section 2. *Loans.* No loans shall be contracted on behalf of the Institute, and no negotiable papers other than checks, shall be issued in its name, unless and except as authorized by a majority vote of the Council.

Section 3. *Deposits.* All funds of the Institute shall be deposited from time to time to the credit of the Institute in such banks or trust companies or with such other depositories as the Council may select, or as may be selected by an officer or officers, agent or agents, of the Institute to whom such power may from time to time be designated by the Council.

Section 4. *Checks, Drafts, Etc.* All notes, drafts, acceptances, checks, endorsements, or other evidence of indebtedness shall be signed by such officers of the Institute as the Council may from time to time by resolution provide.

Section 5. *Investments.* The funds of the Institute may be invested and reinvested in such manner and for such purposes as may be lawful and authorized by resolution of the Council.

Section 6. *Disposition of Surplus Funds.* Any surplus in excess of normal operating requirements, plus a reasonable reserve to be determined by the Council, shall be used to increase man's knowledge of food technology and to provide additional educational facilities by the establishment and maintenance of scholarships and fellowships to deserving students; grants and endowments to educational institutions or scientific publications; and awards for outstanding contributions of new knowledge in the field of food technology. This shall be done under such rules and regulations as the Council may prescribe; provided that no preference or discrimination shall be made therein because of the race or religious creed of any individual or individuals.

ARTICLE XIV

Limitation of Liability

Notwithstanding anything to the contrary contained in this Constitution, no agreement, contract, or obligation (other than a check), involving the payment of money or the credit or liability of the Institute for more than One Thousand Dollars ($1,000.00) shall be made without the approval of the Council.

ARTICLE XV

Subsidiary Organizations

Section 1. *Regional Sections.* The Council shall grant authority in the form of a charter to organizations of members of the Institute living in the same geographical region, for the establishment of a Regional Section, when such organization shall have complied with the conditions set forth in the By-Laws of the Institute.

Section 2. *Regional Section Associates.* Persons not qualified for membership in the Institute, but who have an interest in food technology, may be admitted to associate membership in a Regional Section, provided that the total number of such associate members does not exceed twenty-five percent (25%) of the total membership of that Regional Section. Associate members shall not be counted in determining the representation of a Regional Section on the Council of the Institute.

Section 3. *Membership in Regional Sections.* Membership in a Regional Section shall be entirely voluntary on the part of members of the Institute. A member may or may not belong to the Regional Section wherein he resides, or any other Regional Section, or may belong to two or more Regional Sections, as he chooses. In no case shall any member be counted more than once

in determining Regional Section representation on the Council.

Section 4. *Dissolution of Regional Sections.* When any Regional Section shall cease to function as a Section of the Institute for a period of more than one year, or shall hold less than three meetings in any one year, or if its membership shall be less than twenty-five (25) members of the Institute for a period of one year, the Council may terminate the charter of such Regional Section. Such dissolution of a Regional Section shall not affect the membership standing in the Institute of the members of that Section.

Section 5. *Student Chapters.* The Council may grant authority in the form of a certificate to organizations of Student Members of the Institute attending any one educational institution for the establishment of a Student Chapter when the organization has met the conditions set forth in the By-Laws of the Institute.

ARTICLE XVI

Amendments

All or any part of the Constitution of the Institute, now or hereafter adopted, shall be subject to amendment, alteration or repeal, or a new Constitution may be adopted by a majority vote of the members voting in the manner prescribed herein. Amendments, alterations, or repeal of any part of the Constitution or the adoption of a new Constitution may be proposed by a two-thirds majority vote of the Council or a majority vote of two or more Regional Sections approved by a majority vote of the Council. When thus proposed the Executive Secretary shall submit the question by mail to the members entitled to vote. Thirty (30) days after mailing, the ballots received shall be counted in the manner prescribed in Article VIII, Section 2, for the election of officers and Councilors-at-Large.

ARTICLE XVII

Dissolution

Section 1. *Voluntary Dissolution.* In the event dissolution of the Institute appears desirable, the Council shall adopt a resolution recommending the dissolution of the Institute, together with a plan of distribution, and direct that the question of such dissolution and plan of distribution be submitted to the voting members of the Institute. The Executive Secretary or his office shall send a copy of such resolution by mail to each voting member not less than thirty (30) days nor more than forty (40) days before the date the ballots are to be counted. The ballots shall be counted in the manner prescribed in Article VIII, Section 2, for the election of officers and Councilors-at-Large. The resolutions to dissolve the Institute and to adopt a plan of distribution will each become effective upon approval of two-thirds of the members voting.

Section 2. *Distribution of Assets.* Upon the dissolution of the Institute the assets shall be applied and distributed first to the final payment and discharge of all liabilities and obligations of the Institute. Any assets held upon condition requiring return, transfer, or conveyance upon the dissolution of the Institute shall be distributed in accordance with such requirements. Any remaining assets shall be distributed pursuant to the plan of distribution adopted, to such similar associations as may be designated therein.

ARTICLE XVIII

Waiver of Notice

Any person entitled to any notice required to be given under the provisions of the General Not-for-Profit Corporation Act or under the provisions of the articles of incorporation or this Constitution, may sign a waiver thereof in writing which shall be deemed equivalent to the giving of such notice.

ARTICLE XIX

Informal Action by Members

Any action required to be taken at a meeting of the members may be taken without a meeting if a consent in writing, setting forth the action so taken, shall be signed by all of the members entitled to vote with respect to the subject matter thereof.

ARTICLE XX

By-Laws

The Council may by a majority vote adopt a set of By-Laws for carrying out the provisions of this Constitution, and may from time to time amend, alter, or repeal such By-Laws.

BY-LAWS

ARTICLE I

Order of Business

Section 1. At meetings of the Members of the Institute the order of business shall be in accordance with the program prepared by the Committee on Programs, and approved by the President.

Section 2. Rules contained in "Pocket Manual of Rules of Order" by Henry M. Roberts shall determine the parliamentary practices of the Institute in all cases where it applies, when not inconsistent with the Constitution or By-Laws of the Institute.

ARTICLE II

Dues

Section 1. The dues year shall be from January 1st to December 31st of one calendar year.

Section 2. The dues for Professional Members and Members shall be $7.50 per year; for Student Members $2.50 per year. These dues shall include a subscription to FOOD TECHNOLOGY and 50% of the dues paid shall be so credited on the books of the Institute.

Section 3. When an applicant has been elected to membership of any class his membership shall become effective immediately and his subscription to FOOD TECHNOLOGY shall begin with the next issue. The payment received with the application shall be credited to the member's account at the rate of 65c per month for the remainder of the calendar year, and the balance of the payment credited to the next succeeding year. In the case of Student Members the entire payment shall be credited to the current calendar year.

ARTICLE III

Meetings

Section 1. The Council shall fix the time and place for the Annual Meeting of the Institute. One or more Regional Sections shall be host to the Institute at such meetings. The Regional Section or Sections desiring to be host at an Annual Meeting shall extend an invitation to the Council at least two years prior to the date of the meeting, setting forth the time and place it is proposed to hold such meeting.

ARTICLE IV

Fiscal Procedure

Section 1. The fiscal year of the Institute shall be from May 1st of one calendar year to April 30th of the following calendar year.

Section 2. The Council shall adopt an annual budget, appropriating funds for the operation of the Institute for one year in advance. No expenditures in excess of the budget shall be made except upon specific authorization by the Council. Should no new budget be adopted prior to expiration of a budget period, expenditures may be continued on a month to month basis at the rate prescribed in the last budget, until such time as a new budget is adopted.

ARTICLE V

Executive Secretary

Section 1. *National Headquarters.* The Executive Secretary shall keep the minutes of meetings of the Institute, the Council, and the Executive Committee of the Council. He shall be the custodian of the books of account, membership rolls, and records of the Institute. He shall receive all monies paid to the Institute and promptly deposit same in the designated depositories. He shall keep a double entry set of books with accounts for all items shown in the annual budget and such other accounts as may be necessary. The original records of entry shall be in the form of vouchers that identify the debits and credits by account and shall carry a running cash balance. The vouchers shall be prepared in triplicate. The original shall be filed in the office of the Executive Secretary, and all original invoices, receipts and supporting papers filed therewith. The duplicate copy of the voucher shall be forwarded to the Treasurer and the triplicate copy to the President. The Executive Secretary shall prepare quarterly and send to each member of the Council a budget status report listing all budget items and showing the amounts received or expended under each, and such other information as the Council may deem necessary. The Executive Secretary shall maintain the National Headquarters of the Institute, and shall purchase, hire, or contract for such services, supplies and equipment as are necessary for its operation and within the limitations of the budget fixed by the Council. He shall cause the accounts of the Institute to be audited annually by a certified public accountant. He shall make an annual report to the Council, showing the status of memberships with gains and losses for the year; a financial statement, including the annual report of audit; a resume of the operations of his office; and such other items as the Council may from time to time direct. The Council shall determine annually the amount of the surety bond of the Executive Secretary.

Seection 2. *Publications.* The Executive Secretary shall be the Business Manager of the Journals published by the Institute. As Business Manager he shall purchase or hire such supplies and services that he finds necessary for the operation of the Journals, excepting those pertaining to editing and manufacturing; provided that no obligations in excess of budget limitations shall be incurred, and no agreement that cannot be terminated within 60 days shall be made without spe-

cific authorization by the Executive Committee. The foregoing shall not apply to the acceptance of space contracts submitted by advertisers. He is authorized to accept space contracts from and assign space positions to advertisers within those sections of the Journals wherein the Editor has authorized advertising to appear. He shall refer to the Editor for decision on acceptance or rejection of any advertising of an apparently unethical nature or inconsistent with the professional standards of the Journals. He shall fix the advertising rates, and negotiate contracts for the manufacture of the Journals, subject to approval by the Executive Committee of the Council; and the Council by this By-Law delegates to its Executive Committee authority to approve such rates and manufacturing contracts. The approval of the Executive Committee shall be certified on original manufacturing contracts and rate schedules by the President. The Executive Secretary shall keep the Editor informed of current incomes and costs of the journals in order that the latter may intelligently plan issues within budget limitations.

Section 3. *Funds.* The funds of the Institute shall be deposited only in banks covered by Federal Deposit Insurance so long as that insurance is available. There shall be two or more accounts:

a. A General Account (or accounts) into which all monies received shall be deposited. All checks drawn on this account shall bear the signature of any two of the following listed officials of the Institute: The Executive Secretary, the Treasurer and the Assistant Treasurer. The signature of the Assistant Treasurer will be used only when the Treasurer or the Executive Secretary is not available.

b. An Operating Account for all operating expenditures. Deposits in this account shall be only by checks drawn on the General Account or accounts. The balance to be carried in the Operating Account shall not exceed $10,000. Checks drawn on this account shall be signed by the Executive Secretary or Assistant Executive Secretary.

Section 4. Procedure for handling applications for membership:

a. *Applications for Membership.* Upon receipt of an application for membership in the Institute, accompanied by a payment of $7.50, the Executive Secretary shall verify the completeness of the application and the eligibility of the endorsers. The application shall then be forwarded to the Chairman of the Committee on Qualifications and the applicant notified of the action taken. Upon election the applicant shall be so notified and furnished a membership card for the current year.

b. *Applications for Student Membership.* Upon receipt of an application for Student Membership, accompanied by a payment of $2.50, it shall be processed as outlined in a. above.

c. In the event an applicant is not elected to any class of membership, he will be so advised and his payment refunded.

Section 5. *Change of Status.*

a. When a Member desires to change his status from Member to Professional Member, he shall complete that portion of the membership application form relating to experience and present employment, sign, and forward it to the Executive Secretary, who shall send it to the Chairman of the Committee on Qualifications. If approved by that Committee, the Executive Secretary shall change the membership records accordingly and so inform the member. If the change of status is disapproved by the Committee, the Executive Secretary shall so notify the member, giving the reasons for disapproval.

b. When a Student Member has graduated and entered upon a career in Food Technology by accepting employment in that field, his status may be changed to Member upon his furnishing the Executive Secretary a written statement showing date of graduation, degree received, name of employer, and position held. A Student Member whose status is changed to Member shall not be required to pay the difference in dues for the remainder of the current calendar year unless he desires to surrender his Student Membership card and receive a Member's card, in which case the difference in dues shall be prorated at 45c per month for the remainder of the current calendar year.

c. When a Student Member leaves his educational institution prior to graduation, or does not enter a career in Food Technology after graduation, and nevertheless desires to become a Member, the procedure for change of status shall be as prescribed in a. above.

Section 6. Original applications for Student Membership must be endorsed by one or more members of the faculty who are also members of the Institute of Food Technologists.

Section 7. Annual renewals of student membership must be accompanied by a statement that the person named therein is a regularly enrolled student in one or more of the sciences or branches of engineering associated with food technology and this statement must be signed by the head of the department, or by any other faculty member who is also a member of the Institute of Food Technologists.

ARTICLE VI

Treasurer and Assistant Treasurer

Section 1. *Appointment and Term of Office.* The Treasurer shall be appointed annually by the Council and shall be eligible for reappointment at the discretion of the Council. He shall be ex-officio Chairman of the Finance Committee. The Council shall determine annually the amount of the surety bond of the Treasurer.

Section 2. *Budget.* The Treasurer shall cause to be prepared the annual budget of the Institute. The budget shall be reviewed by the Finance Committee before presentation to the Council.

Section 3. *Funds.* The Treasurer shall have general supervision over the financial records of the Institute and shall present to the Council annually a report of all receipts and disbursements of Institute funds.

Section 4. *Assistant Treasurer.* An Assistant Treasurer shall be appointed annually by the Council and shall be eligible for reappointment at the discretion of the Council. The Assistant Treasurer shall, in the

absence of the Treasurer, perform the duties of that office and such other duties as may be from time to time assigned to him by the Council. The amount of the surety bond of the Assistant Treasurer shall be determined annually by the Council.

ARTICLE VII

Editor and Editorial Board

Section 1. The Editor of Institute Journals shall be appointed annually by the Council and shall be eligible for reappointment at the discretion of the Council. The Editor shall be responsible to the Council for the production, issue and quality of the Journals. He shall determine the contents, size and makeup of each issue within the limitations of the budget fixed by the Council. He shall designate those portions of the Journals wherein advertising may appear. He shall have authority to cause the cancellation of space contracts for or the rejection of advertising that he deems unethical or inappropriate for Institute Journals. He shall be guided by the policies fixed by the Council with respect to the scope and type of subject matter carried in Institute Journals. He shall submit annually to the Council a report dealing with the operations of his office and containing such recommendations as he deems appropriate. Should any differences arise between the Editor and the Business Manager of the Journals or other officers or Committees of the Institute with respect to editorial functions the matter shall be submitted to the Executive Committee of the Council; and the Council by this By-Law delegates to its Executive Committee authority to resolve such differences.

Section 2. *Associate Editors.* There shall be Associate Editors for each Journal. Their number shall be determine from time to time by the Council. Associate Editors shall be appointed by the Editor subject to approval by the Executive Committee of the Council; and the Council by this By-Law delegates to its Executive Committee authority to approve such appointments. Associate Editors shall be appointed for terms of three years, and may not be reappointed to succeed themselves. Associate Editors shall perform such duties as may be assigned to them by the Editor.

Section 3. *Editorial Board.* There shall be an Editorial Board consisting of the Editor, who shall be ex-officio Chairman, and the Associate Editors of the Institute Journals. The Editorial Board shall assist the Editor in interpreting and carrying out the policies of the Council and perform such other functions as may be designated by the Editor. The operating procedures of the Board shall be prescribed by the Editor. The Board shall have final authority to accept or reject technical papers for publication in the Journals.

Section 4. Rules governing the presentation of papers at Annual Meetings.

(1) The term "paper" shall include any presentation for which the title and author are listed on the program and which may be reduced to writing either prior to, during, or subsequent to the meeting at which it is presented.

(2) No paper may be presented at an Annual Meeting, which has been offered for publication in any journal except those of the Institute of Food Technologists, unless it has previously been released by the Editor and provided it has not appeared in print prior to the Meeting.

(3) No paper shall be presented at an Annual Meeting unless its title appears on the program for the Meeting.

(4) Each paper presented before an Annual Meeting shall be the property of the Institute of Food Technologists for publication in the Institute's Journals. The Editor of FOOD TECHNOLOGY and of FOOD RESEARCH is empowered to release such papers for publication elsewhere. No paper shall be presented at the Meeting unless the author agrees to the condition that the paper is the property of the Institute.

(5) In case a title has been submitted and it becomes clear to the Program Committee that arrangements violating the above points have been made by the authors, the paper will be omitted from the program and will not be allowed to be delivered.

(6) The Institute shall not be responsible for statements or opinions advanced by individuals in papers or discussions before its meetings.

(7) The President shall have authority to exclude any paper from the program at any time prior to its presentation at the meeting of the Institute.

Section 5. Rules for the use of trade names in articles published in FOOD TECHNOLOGY and FOOD RESEARCH, and comparing the merits of two or more products of commerce.

(1) Trade names are to be avoided in defining products dealt with, except where in the judgment of the Editor the maximum value of the paper cannot be otherwise retained.

(2) If trade names are used for any of the commodities compared, all of the commodities having trade names should be so designated, if practicable.

(3) If trade names are used, the commodities in question must be described in sufficient detail to make the nature of such products sufficiently clear to professionally trained readers.

ARTICLE VIII

Subsidiary Organizations

Section 1. *Regional Sections.* The Council may grant Regional Section Charters to organized groups of members of the Institute residing in the same geographical area when the following conditions have been met:

a. That the paid-up membership of the organization shall include not less than 25 members of the Institute, excluding Student Members.

b. That the organization has adopted a Constitution and/or By-Laws not in conflict with the Constitution of the Institute.

c. That the organization has held not less than three stated meetings during the preceding twelve months.

d. That the organization has elected three individuals to hold the offices of Chairman, Secretary and Councilor.

e. That the organization has petitioned the Council in the form of a letter addressed to the Executive Secretary. This letter shall include:

1. The names and addresses of the members.
2. The names and addresses of the Chairman, Secretary and Councilor.
3. Date of organization and dates on which the three last meetings were held.
4. The name the Regional Section is to bear.
5. The geographical boundaries of the area the organization desires to include.
6. A copy of its Constitution or By-Laws.
7. The petition shall be signed by the Chairman and Secretary of the organization.

The Executive Secretary shall verify the fact that a, b, c, and d have been complied with and submit the request for granting a charter to the Committee on Regional Sections for study and recommendations.

The Committee on Regional Sections shall render a report to the Executive Secretary indicating its recommendation with reference to establishment of the proposed section and its boundaries. The Executive Secretary shall then submit the question of granting a charter to the Executive Committee of the Council for approval or disapproval. The Council, by this By-Law, delegates to its Executive Committee the authority to approve or disapprove petitions for Regional Section charters.

When the Executive Committee of the Council has approved the chartering of a new Section, the Executive Secretary shall officially notify the new Regional Section of such approval.

Section 2. *Student Chapters.* The Council may grant a Certificate for the establishment of a Student Chapter to an organization of Student Members of the Institute attending one educational institution when the organization petitions the Council for such a Certificate. Student Chapter Certificates may be issued when the following requirements have been met.

a. That the organization consists of not less than ten Student Members of the Institute registered at one educational institution.

b. That the organization has had an uninterrupted continuity of existence of not less than one year during which it *shall* have held not less than three stated meetings.

c. That the organization is recognized as a campus group by the educational institution.

d. That at least one member of the faculty, who is a member of the Institute, sponsors the petitioning organization.

e. That the organization has adopted a set of By-Laws not inconsistent with the Constitution and By-Laws of the Institute.

The Council, by this By-Law, authorizes its Executive Committee to approve or disapprove petitions for Student Chapter Certificates.

f. The petition for Certificate shall be signed by at least one sponsor, and shall:

1. List the names of the members and officers of the organization.
2. State date of organization.
3. State dates of last three meetings.
4. Include a copy of the By-Laws of the organization.

ARTICLE IX

General

Section 1. *Executive Committee Nomination and Election.*

a. The five elected members of the Executive Committee shall be elected from the active members of the Council by the following procedure:

At the Annual Meeting, the President-Elect shall appoint a Nominating Committee of five Council members, no two of which shall be from the same Regional Section. The Nominating Committee shall meet prior to the close of the Annual Meeting, and shall select from the list of active Council members a slate of not less than seven and not more than ten, no two of which shall be from the same Regional Section. The Nominating Committee shall present to the Executive Secretary the name of the individuals nominated, and the Executive Secretary will then send to each member of the new Council an informal ballot requesting that each Councilor vote for five of the nominees. The five who have received the highest number of votes three weeks after the mailing of the ballot shall be notified that they are members of the Executive Committee of the Council.

b. The five elected Committee members shall continue in office for one year, or until the succeeding Executive Committee shall be declared elected.

c. A member of the Executive Committee may be elected to succeed himself on the Committee, provided he continues as a member of the Council.

Section 2. *Executive Committee. Duties and Functions.* Except as herein provided or unless specifically authorized by resolution of the Council, all actions of the Executive Committee must be approved by the Council before becoming effective. Immediately following any meeting of the Executive Committee, the Executive Secretary shall prepare the proceedings of the meeting and submit a draft of these proceedings to the President for his approval. Upon his approval copies shall be mailed to all members of the Council with a suitable ballot on which the Councilors may indicate their approval or disapproval of each action taken. Twenty days after the mailing of the proceedings and ballots to the Councilors, the Executive Secretary shall tabulate the results of the voting and transmit this tabulation and the ballots to the President, together with a copy of the proceedings. The President shall certify the approval or disapproval of the Council on the copy of the proceeedings and return same to the Executive Secretary for filing in the Book of Minutes of the Institute. A majority of the members of the Council must vote in order to constitute a quorum for a mail ballot of the Council.

ARTICLE X

Any previous action of the Council that is in conflict with these By-Laws is hereby rescinded.

acid and the process repeated. This extract varied between pH 2.0-2.3. The final extraction was repeated with boiling 0.4% sodium hexametaphosphate which gave a pH 6.4-6.9. The alcohol precipitates from each component part were combined, washed 3 times with 70% isopropyl alcohol, and finally twice with the 99% alcohol. The washed alcohol precipitates were dried under vacuum at 70° C. (158° F.) for 12 hours. After drying, 0.2 g. of the alcohol precipitates was dispersed in warm water and made to a volume of 200 ml. Calcium pectates were determined according to the method of Carré and Haynes *(1)* and reported on wet tissue and dry solids basis.

RESULTS AND DISCUSSION

During the commercial extraction of juice from citrus fruit there are introduced into the juice various parts of the fruit which make up the pulp content. A large majority of the pulp content consists of juice sacs and rag. Although the coarse particles are eliminated by the finishing process, a finished product may contain from 4 to 12% pulp by volume. A limited amount of pulp in citrus juices is desirable because it gives to reconstituted citrus concentrates the appearance of freshly reamed juice and adds pectic material which contributes to the consistency and "cloud" of the product. The enzyme, pectinesterase, which is associated with the solid particles, is introduced when the pulp is added and if not inhibited may sometimes cause undesirable physical qualities in frozen concentrate, because this enzyme will demethylate and degrade the hydrophilic colloid, pectin. The former will cause gelation and the latter clarification in frozen concentrate.

The component parts of the 7 varieties of citrus fruits are briefly described as follows:

(a) Flavedo, known as the epicarp, is the outer colored portion of the peel.

(b) Albedo is the white spongy portion known as the inner mesocarp. This also includes the central core.

(c) Rag consists of the segment membranes or wall tissue enclosing the juice sacs.

(d) Seeds.

(e) Juice sacs are the vesicles which hold the juice.

(f) Juice is the liquid contained in the sacs. The juice was centrifuged to free it of insoluble solids.

The fruits were selected to meet the maturity standards as found in the Florida Citrus Code of 1949 *(10)* and the chemical analyses of the juices from the 7 varieties of citrus fruits are shown in Table 1.

The distribution of pectinesterase activity in the component parts of citrus fruit is presented in Table 2. Without exception as to variety the highest activity was found in the juice sacs while the least amount of activity was found in the centrifuged juice. The activity found in the seeds may have been partly due to broken juice sacs that adhered to the seed coating in spite of the fact that the seeds were gently rubbed between cheese cloth to remove any clinging substance. A prospective comparison of activity between components of any one variety and between the components of different varieties can be made only when taking into consideration the moisture content of each component. Thus, the data presented in Table 2 are expressed on wet tissue and dry solids basis.

TABLE 1

Chemical analyses of citrus juices

Variety of fruit	Date of harvest 1952	Refractometer at 28° C. ° Brix	Total acid as citric %	Brix/acid ratio	pH
Dancy tangerine	Jan. 10	10.5	0.72	14.6	3.7
Hamlin orange	Jan. 22	9.6	0.58	16.4	3.9
Pineapple orange	Feb. 11	12.5	0.87	14.2	3.8
Temple orange	Apr. 4	13.8	0.90	15.4	3.6
Valencia orange	Apr. 21	11.3	0.81	14.0	3.8
Marsh seedless grapefruit	Feb. 18	9.4	1.25	7.6	3.2
Duncan grapefruit	Apr. 10	10.4	1.45	7.2	3.4

The distribution of total pectin and the moisture content in the 6 component parts of citrus fruit is presented in Table 3. Pectin is expressed as calcium pectate on both a wet weight and dry weight basis. The juice was lowest in pectin content and the seeds were relatively low. On a dry weight basis the rag usually contained the highest amount of total pectin although in some cases the flavedo and albedo were higher, especially the flavedo of the Marsh Seedless grapefruit. The juice sacs contained a good supply of pectin ranging from 9 to 15.5% on a dry weight basis. The rag and juice sacs are the 2 component parts which make up the majority of pulp in citrus juices or concentrates and it should also be noted that these contained the highest pectinesterase activity.

TABLE 2

Distribution of pectinesterase activity in the component parts of citrus fruits

Variety of fruit	Flavedo		Albedo		Rag		Juice sacs		Seeds		Juice	
	(PE.u.)g. $\times 10^3$		(PE.u.)g. $\times 10^3$		(PE.u.)g. $\times 10^3$		(PE.u.)g. $\times 10^3$		(PE.u.)g. $\times 10^3$		(PE.u.)g. $\times 10^3$	
	wet basis	dry solids	wet basis	dry solids	wet basis	dry solids	wet basis	dry solids	wet basis	dry solids	wet basis	dry solids
Dancy tangerine	15.8	63.2	16.9	38.7	13.5	66.0	45.7	244.6	4.6	10.3	0.01	0.1
Hamlin orange	15.6	65.8	10.6	43.9	22.8	134.8	55.3	371.9	3.6	6.5	0.1	1.0
Pineapple orange	14.6	55.2	8.5	30.4	23.8	109.3	129.9	794.5	6.5	14.2	0.4	3.1
Temple orange	10.7	47.4	9.0	34.4	25.6	136.6	75.0	441.4	3.8	7.0	0.2	1.6
Valencia orange	9.5	34.4	6.6	20.7	14.1	65.4	76.0	474.3	4.0	8.8	0.2	1.9
Marsh seedless grapefruit	17.2	78.4	12.8	65.6	6.9	39.4	30.0	245.3	0.9	2.2	0.2	2.0
Duncan grapefruit	9.8	43.1	11.4	53.1	7.1	41.6	39.9	318.1	2.2	4.7	0.3	3.3

TABLE 3

Distribution of total pectin in the component parts of citrus fruits

Variety of fruit	Flavedo			Albedo			Rag			Juice sacs			Seeds			Juice		
	% Moisture	% Ca pectate wet basis	% Ca pectate dry basis	% Moisture	% Ca pectate wet basis	% Ca pectate dry basis	% Moisture	% Ca pectate wet basis	% Ca pectate dry basis	% Moisture	% Ca pectate wet basis	% Ca pectate dry basis	% Moisture	% Ca pectate wet basis	% Ca pectate dry basis	% Moisture	% Ca pectate wet basis	% Ca pectate dry basis
Dancy tangerine	75.0	2.4	9.7	56.4	5.4	12.3	79.5	2.9	14.3	81.3	2.6	13.9	55.4	0.5	1.1	89.1	0.01	0.1
Hamlin orange	76.3	4.3	18.2	75.8	4.5	18.8	83.1	2.5	14.7	85.1	2.3	15.5	44.7	2.5	4.5	90.3	0.07	0.8
Pineapple orange	73.6	3.9	14.8	72.1	4.4	15.7	78.2	4.3	19.9	83.6	1.8	11.1	54.1	3.5	7.5	87.2	0.11	0.9
Temple orange	77.5	2.4	10.8	73.9	4.4	16.7	81.3	3.1	16.5	83.0	1.5	9.0	46.7	3.4	6.4	86.8	0.05	0.4
Valencia orange	72.4	5.0	18.1	68.2	8.7	27.5	78.4	7.7	35.4	84.0	2.5	15.3	54.8	3.8	8.4	88.9	0.09	0.8
Marsh seedless grapefruit	78.1	6.8	31.2	80.5	2.7	13.9	82.4	3.5	20.0	87.8	1.8	14.6	57.1	2.3	5.4	91.7	0.08	0.9
Duncan grapefruit	77.3	4.5	20.0	78.6	2.8	13.0	82.8	4.1	24.1	87.5	1.6	12.7	54.7	2.2	5.1	90.1	0.08	0.8

Tangerine. The Dancy variety was chosen because it is more abundantly grown in Florida than any of the other mandarin varieties. The results reported in Table 2 show that the order of component parts in activity, highest to lowest, is juice sacs, rag, flavedo, albedo, seeds, and juice on a dry solids basis. The albedo of the Dancy tangerine was very dry and fibrous having a moisture content of 56.4% which was unlike the albedo found in the other citrus fruits studied. Data in Table 3 show that the order of component parts for pectin content on a dry basis is similar to that for activity except that the order of flavedo and albedo are reversed.

Orange. The 4 popular varieties of Florida oranges studied were Hamlin (early), Temple and Pineapple (mid-season), and Valencia (late). The order of highest to lowest activity in the orange component parts was found to be the same as for the tangerine above. The pectinesterase units in the juice sacs and rag of the oranges were usually higher than those found in the tangerine and grapefruit. The pectic content followed no particular pattern except that already mentioned above. The rag and albedo of the Valencia orange contained a much higher pectic content compared to the other 6 varieties analyzed, 35.4 and 27.5%, respectively.

Grapefruit. The Marsh Seedless and Duncan varieties of grapefruit were selected for this study because these 2 varieties are widely used by the processors in Florida. The component part most active in pectinesterase, like that found for tangerine and oranges, was the juice sacs. Unlike the oranges, the rag of grapefruit was not second highest in activity, but fourth, being replaced by flavedo and albedo. The pectic content of the components in the 2 varieties follow no similar pattern on a dry basis, but when expressed on a wet basis the highest to lowest in pectic content for the 2 varieties is flavedo, rag, albedo, seeds, juice sacs, and juice.

SUMMARY

Pectinesterase activities and total pectins were determined on the flavedo, albedo, rag, juice sacs, seeds, and juice for one variety of mandarins, 4 varieties of oranges, and 2 varieties of grapefruit. Without exception the highest pectinesterase activity was found in the juice sacs, while the least amount of activity was found in the juice. The order of component parts for pectinesterase activity per g. of dry solids for tangerine and oranges from highest to lowest activity was found to be juice sacs, rag, flavedo, albedo, seeds, and juice. In the grapefruit varieties the flavedo and albedo exhibited high activity.

The pectic content on a dry solid basis was found to be highest in the rag for Dancy tangerine, Pineapple, Temple and Valencia oranges, and Duncan grapefruit. In the Hamlin orange pectin was highest in the albedo and in the Marsh Seedless grapefruit pectin was highest in the flavedo.

The pulp content of citrus juice consists mainly of rag and juice sacs, both of which contain a high percentage of pectin and a high pectinesterase activity. As pulp levels are increased in citrus juices these factors may be expected to influence the degree of gelation and clarification.

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A Rapid Test for Adequacy of Blanching in Frozen Brussels Sprouts

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By subjective appraisal and enzyme assay it is confirmed that the peroxidase test of Masure and Campbell serves as a satisfactory index for adequacy of the blanching operation applied to Brussels sprouts. On addition of 0.5-3% solution of hydrogen peroxide to Brussels sprouts halves color development roughly paralleled peroxidase content of samples. It is suggested that this simple rapid test be used instead of the peroxidase test to determine adequacy of blanching in Brussels sprouts to be preserved by freezing.

Because of differences in size and in compactness of individual units, Brussels sprouts offer problems in blanching not normally encountered with other vegetables preserved by freezing. Some processors have alleviated the difficulties to a degree by size grading. Within a given size group, however, the heat requirements for adequate blanching may vary considerably, as a result of differences in compactness of individual sprouts.

With Brussels sprouts, blanching much beyond the point of adequacy is undesirable, since the extra heating brings about changes in color which detract significantly from appearance. These changes have been demonstrated repeatedly in unpublished studies made by the authors. Because of the need for careful control of blanching, a simple and rapid test which could be applied routinely would have considerable value to processors. The present communication describes studies that resulted in such a test for adequacy of blanching in Brussels sprouts preserved by freezing.

Lindquist, Dietrich, Masure, and Boggs *(1)* recently reported that Brussels sprouts blanched to a degree sufficient to inactivate peroxidase as determined by the Masure and Campbell test *(3, 4)* retained quality at —10° F. (—23° C.) for 10 months.[b] On the other hand, materials which showed a positive peroxidase reaction developed a marked off-flavor and showed a pink discoloration at the centers under these same conditions of storage. From the high correlation between off-flavor and pink discoloration, it was concluded that samples which exhibit this color are most likely to be inferior.

The results reported in the original study were obtained on a group of samples examined after 10 months of storage. Later unpublished studies showed the presence of pink centers and off-flavors in frozen material as early as one month after storage and, in one instance, a limited evaluation showed significant changes after storage for one week under the same conditions (—10° F. or —23° C.).

In all previous investigations, interest centered on the concurrent development of off-flavor and pink centers in the frozen materials. Since it was not known whether freezing is a necessary step in the development of the abnormal discoloration, investigation of this point seemed in order. If it could be shown that pink-center development occurred prior to freezing and could be correlated with degradation in quality of the frozen product, such observations could be used as a quick test for adequacy of blanching.

Studies to investigate these points were initiated in February, 1951. Concurrently, the effect of holding raw material (between harvest and processing) on abnormal color development was investigated. Results showed that sound raw material could be held at 40° F. (4° C.) for a period up to 8 days after harvest without abnormal discoloration in the processed product if adequately blanched. Inadequately blanched materials[c] prepared from the same raw stock, although they showed no abnormal color development when examined immediately after blanching, developed the abnormality within the interval from 45 minutes to 2 hours after blanching in 10 to 30% of the pieces. The findings were essentially the same whether the sprouts were cut immediately after blanching or allowed to remain whole in the interim period before final examination. Thus, freezing is not a necessary step in the development of pink centers in Brussels sprouts.

EXPERIMENTAL

Since only 10 to 30% of the samples showed abnormal discoloration in spite of the fact that all of the pieces were underblanched, a number of reagents were tested in an attempt (a) to accelerate the appearance of discoloration in those materials which show the abnormality on longer standing and (b) to develop the discoloration in underblanched pieces which remained uncolored during the examination period. Of the reagents used, hydrogen peroxide showed greatest promise. The addition of a dilute solution of this reagent to cut halves brought about the rapid development of pinkish discoloration in underblanched material. The concentration range recommended is 0.5 to 3% hydrogen peroxide.

Because of the instability of the reagent, solutions obtained from commercial sources do not always contain the amounts specified on the labels. It is therefore recommended that dilute solutions be prepared by proper dilution of a 30% hydrogen peroxide solution with distilled water. This more concentrated reagent is stable over long periods of time if kept in a refrigerator at 35 to 40° F. (1.7-4° C.). The dilute solutions may also be held for periods up to one week if kept refrigerated when not in use.

The exact concentration of the 30% reagent should be determined by one of the standard methods of assay, such as titration with permanganate, when received. The dilute solu-

[a] Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, United States Department of Agriculture.

[b] Raw materials used in all studies were procured from the Half Moon Bay area of California which is located along the Pacific Coast about 25 miles south of San Francisco. In most instances blanching was carried out in steam at 212° F. (100° C.) and cooling was accomplished by a fog spray drawn through the material with the aid of a suction fan *(1)*.

[c] The Masure and Campbell semiquantitative peroxidase test *(3, 4)* was used as an index of adequacy of blanching.

tions should be similarly analyzed at the time of preparation and at frequent intervals during their use, so that the reagent concentration can be kept within the range recommended.

During the course of these experiments it was also noted that pink color development occurred in samples which had been (a) extensively bruised, (b) moderately bruised prior to a period of delay, (c) frozen, or (d) permitted to decay. In these instances, the rate of appearance of color was somewhat reduced. These observations point to the conclusion that for pink color to develop, the plant tissue must be damaged in some manner and must also contain an active enzyme (probably peroxidase). Such damage can be caused by bruising, freezing, heat, or decay.

Additional samples were prepared in October, 1951, to exploit further the earlier observations and to determine their possible application as a basis for a test of adequacy of blanching in Brussels sprouts. The enzyme assay data and subjective appraisal of the samples are given in Table 1.

These data indicate that the peroxidase test not only serves as a satisfactory index of adequacy of blanching but offers a reasonable margin of safety, as is shown by the fact that the 3-minute-blanched sample, although it contained residual peroxidase sufficient to show a positive semiquantitative test, retained quality during the period of examination. These findings are further substantiated by another series of samples prepared in February, 1950. In this group, materials which contained residual peroxidase but which did not develop pink centers (no peroxide used), retained excellent quality after 12 months of storage at —10° F. (—23° C.).

RESULTS AND DISCUSSION

From the results shown in Table 1, it might be inferred that catalase inactivation would also serve as an index of adequacy of blanching in this particular commodity. However, it has been shown by Lindquist *et al. (1)* and in later unpublished work at this Laboratory that catalase activity gradually disappears in samples during freezing storage. Thus, a sample which might be underblanched according to the catalase test at the time of processing would appear to be adequately blanched if checked by the same test after a few months of storage. The absence of catalase in the frozen material therefore does not necessarily indicate adequate blanching.

The results of treatment of lots prepared in October, 1951, with 3% hydrogen peroxide solution are given in Table 2. (Observations were made immediately after blanching, after 1 day, and 11 weeks in freezing storage.)

These data serve well to emphasize the effect of hydrogen peroxide in the development and enhancement of the pink color in Brussels sprouts which are underblanched according to the peroxidase test of Masure and Campbell *(3, 4)*. As is indicated in groups 1 and 2, the color is developed almost immediately after the addition of the peroxide solution to the underblanched materials. Visual observations have shown that extent of discoloration roughly parallels the peroxidase content of the materials. Since the observations made in group 3 were carried out for the purpose of obtaining data which would serve as the basis for a test for adequacy of blanching, detailed examination was made only at the time intervals noted, namely 10 minutes for samples not thawed previous to cutting and 5 minutes for the samples which had received preliminary thawing. In most cases, however, maximum color had developed long before the interval of final examination. Similar results were obtained on the lot processed in February, 1951, when examined after 48 weeks of storage at —10° F. (—23° C.).

The color which develops in underblanched or bruised samples has been described variously by several observers as pink to orange and very distinctly different from the yellowish cast which is characteristic of the inner portion of the adequately blanched materials. In order to characterize the colors quantitatively, measurements were made with the aid of the Hunter Color and Color Difference Meter, on selected samples from the October, 1951, lot (Table 1).[1] From the data obtained,

[1] The aid of H. C. Lukens and R. P. MacKenzie of the Analytical, Physical Chemical, and Physics Division of this Laboratory in making these measurements is gratefully acknowledged.

TABLE 1

Enzyme assay and subjective appraisal scores[d] of frozen Brussels sprouts processed in October, 1951

			Enzyme Assay				
			Blanching time (min.)[e]				
			0	2	3	5	8
Catalase	K_{Fe}, units	1[f]	0.0693	0.008	0.0	0.0	0.0
		2[g]	0.0085	0.003	0.0	0.0	0.0
	Fermentation Tube test[h]		++++	+++	+	—	—
Peroxidase[i]	D/M, units	1[f]	3000	760	720	51	0
		2[g]	—	571	394	31	0
	Semiquantitative test		+	+	+	—	—
			Subjective Appraisal Scores				
Natural Flavor			—	4.0	5.1	5.3	5.0
Off-flavor			—	3.8	5.4	5.5	5.7

[a] Least difference between scores for P = 0.01: for natural flavor, 0.9; for off-flavor, 0.8.

[d] Appraisal was made after 3½ months of storage at —23° C. (—10° F.) by a panel of 10 selected judges. Scoring was on a 7 to 1 basis, 7 indicating natural flavor and no off-flavor. Samples were presented in random order at 4 taste sessions.

[e] Blanching in boiling water was followed by immediate cooling in a large volume of water at 15.6-18° C. (60-65° F.).

[f] Assay at the time of processing. Method of Lineweaver and Morris *(2)* used for quantitative determination of catalase.

[g] Assay at the time of appraisal.

[h] Known amounts of sample are ground finely, suspended in a small volume of water, and mixed in a fermentation tube with a known volume of 3% hydrogen peroxide solution, care being taken to avoid occlusion of air. The tube is gently shaken for 3 minutes. If the volume of gas present in the tube is greater than that present when a cooked sample is similarly treated, the test is considered positive.

[i] Halves of 20-24 sprouts used in the quantitative test. Quarters of the same sprouts were used in the semiquantitative test.

TABLE 2

Effect of treatment of blanched and frozen samples of Brussels sprouts processed in October, 1951, with 3 percent hydrogen peroxide

Samples	Blanched only, at time of processing		Frozen, 1 day after processing		Frozen, 11 weeks after processing	
	Untreated	Treated with 3 percent Hydrogen Peroxide	Untreated	Treated with 3 percent Hydrogen Peroxide	Untreated	Treated with 3 percent Hydrogen Peroxide
Raw	No color	Purple-pink veins confined almost entirely to leaf bases near center core. Not characteristic of pink color observed in bruised or underblanched materials. After bruising, paired halves showed pink color within 20 seconds after treatment.	71 percent pink within 10 minutes after cutting, 86 percent pink in 2 hours.	86 percent pink within 15 seconds after treatment.	Without preliminary thawing, all showed color within 10 minutes after cutting. After thawing in hot water, 4-5 minutes prior to cutting, all showed color within 5 minutes after cutting.	Without preliminary thawing, all showed color 15-30 seconds after addition of reagent. After thawing 4-5 minutes prior to cutting, all showed color 15-30 seconds after cutting.
Blanched 2 minutes	Color developed within 50 minutes after cutting.	Paired halves all developed full deep purple to pink color 25-30 seconds after the addition of the reagent.	14 percent pink within 10 minutes after cutting, 71 percent pink in 2 hours.	100 percent pink within 15 seconds after treatment.	Without thawing, all pink within 10 minutes after cutting. After thawing, all pink within 5 minutes after cutting.	Same as untreated except color intensified by addition of reagent.
Blanched 3 minutes	Slight pink color 1¼ to1½ hours.	Full pink color developed in paired halves 15-30 seconds after addition of reagent.	14 percent pink within 10 minutes after cutting, 43 percent pink in 2 hours.	100 percent pink within 15 seconds hours after treatment.	Without thawing, no color in samples examined 10 minutes after cutting. After thawing, occasional pink colored sprout in lot examined.	Without thawing, color produced within 10 minutes after treatment. With thawing, color produced within 5 minutes after treatment.
Blanched 5 minutes	No color 1 hour after cutting.	One very large sprout showed color 30 seconds after treatment; all others colorless after 15 minutes.	No color 2 hours after cutting.	57 percent very slightly pink 2 hours after treatment.	No color with or without thawing.	No color in unthawed material. Occasional light colored piece after thawing.
Blanched 8 minutes	No color 1 hour after cutting.	No color 1 hour after cutting.	No color 2 hours after cutting.	No color 2 hours after cutting.	No color with or without thawing.	No color with or without thawing.

descriptions of the colors can be given both in the I. C. I. and Munsell notations. These are given in Table 3.

The values of the dominant wave-length under the I. C. I. system indicate that in the underblanched material, the principal color of the sprout centers is in the orange region of the visible spectrum, while in the adequately blanched material, the color is in the yellow range. Similarly under the Munsell notation, it is indicated that the color of the centers in the case of the underblanched material is a yellow-red while that of the adequately blanched material is yellow. The orange (pink) color in the underblanched samples should not be confused with essentially purple color which develops in raw, unbruised material when treated with hydrogen peroxide, as described in group 1 of Table 2.

In underblanched materials, the appearance of the discoloration follows a more or less definite pattern in which the colored area radiates out from the innermost portion of the stem. Since the inactivation of the enzymes present is dependent on the penetration of heat toward the center of the piece, the size of the area will be smaller as the blanching time is increased. If the discoloration is present but does not appear in this general pattern, it is probably a result of factors other than underblanching, such as bruising, decay, etc., as mentioned earlier. Experiment has shown that if damage has occurred in the raw material tissues as a consequence of any of these factors, the resultant discoloration will persist throughout subsequent processing and freezing operations.

TABLE 3

Description of color of Brussels sprouts centers

Blanching Time (Min.)	I. C. I. System [k] Dominant Wave Length (mμ)	Purity (%)	Luminous Reflectance (%)	Munsell System [l]
2	596	25	27.9	2.5 YR 6/4
5	575	43	39.5	7.5 Y 7/5

[k] Resulting from the International Commission on Illumination Convention in 1931.

[l] Munsell Book of Color (5).

In any event, the presence of the characteristic pink discoloration in the materials after processing is evidence of mishandling or improper processing at some stage of the operation between harvest and freezing.

From the observations reported, the following conditions are proposed as a test for the adequacy of blanching in Brussels sprouts to be preserved by freezing. If no pink discoloration is evident within 5 minutes after the addition of 10 drops of a 0.5-3% solution of hydrogen peroxide to the cut surface of blanched or thawed Brussels sprout halves, the material has been adequately blanched, and will retain quality in freezing storage.

SUMMARY

Brussels sprout samples blanched to varying degrees of enzyme inactivation were prepared. Subjective appraisal and enzyme assay of these materials showed, in agreement with earlier work *(1)*, that the peroxidase test of Masure and Campbell *(3, 4)* served as a satisfactory index of adequacy of blanching for this commodity and offered a good margin of safety in the blanching operation.

It was observed that the addition of a 0.5-3% solution of hydrogen peroxide to the cut surfaces of Brussels sprout halves brought about a rapid development of a pinkish-orange color in underblanched materials. The extent of the color development was found to parallel roughly the peroxidase content of the samples. Because

of the parallelism between peroxidase content and color development by hydrogen peroxide, it has been suggested that the latter be used instead of the peroxidase test as a simple, rapid test for adequacy of blanching in Brussels sprouts to be preserved by freezing. The conditions for carrying out such a test have been described.

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Peanut Butter. III. Effect of Roasting, Blanching and Sorting on the Content of Oil and Free Fatty Acids of Peanuts

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The effect of roasting, blanching, and sorting on the oil and free fatty acids of peanuts in the manufacture of peanut butter has been determined. The removal of testa (skin) and germs (hearts) has the effect of increasing the oil content and at the same time decreasing the free fatty acids content of the finished product as compared with the values obtained for the corresponding raw or roasted products. The oil contents of peanut butters containing only added salt and of peanut butters containing stabilizers as well as added salt were compared to show the increases in oil content occasioned by incorporation of stabilizers.

Peanut kernels are composed of approximately equal weights of fatty and non-fatty constituents, the relative amounts of each depending upon variety and quality of the peanuts *(5a)*. Most of the fatty constituents are contained in the cotyledons (peanut halves), some are found in the germs (hearts), and small amounts are generally found in the testa (skin) *(4, 5b)*.

The manufacture of peanut butter *(2)* essentially requires thorough roasting of peanut kernels, blanching of the roasted kernels to remove the testa, screening of blanched kernels to remove the majority of the germs, manual sorting of blanched kernels to eliminate objectionable and extraneous material, and grinding of the remainder with salt and stabilizers into the finished product.

It might be expected that the times and temperatures *(10)* used in roasting would affect the oil contents of the components. Furthermore, it might be expected that the percentage of oil of the roasted material used in making peanut butter would be determined largely by the oil content of the roasted cotyledons, because most of the other components of the peanut kernel have been eliminated by blanching and sorting. The relative proportions of oil and meal in this material are important in the manufacture of peanut butter, particularly from the standpoint of the amount of stabilizer that should be added to prevent separation of oil *(3)*.

The free fatty acids content of peanuts in the manufacture of peanut butter was investigated to determine the importance of this factor in the quality of the product.

Data are presented here on the effects of roasting, blanching, and manual sorting of peanuts and of the incorporation of stabilizers on the oil and free fatty acids contents of peanut butter.

EXPERIMENTAL

Peanuts. The peanuts used in this investigation were No. 1 grade, shelled white Spanish *(9)*, obtained from a shelling plant in southeastern United States.

Processing conditions. The peanuts were roasted in two-bag (250-lb.) batches in a natural gas-fired, radiant-heat roaster *(2)*. The roasted peanuts were cooled, mechanically blanched, and manually sorted to eliminate objectionable material. Details of the processing conditions have been reported *(10)* previously, and only sufficient information is given here to identify the finished product. The blanched, sorted peanuts were ground into peanut butter at the rate of about 240 pounds per hour in an 8-inch, vertical attrition mill, either alone, or with added salt, or with added salt and stabilizer.

Stabilizers. Some of the peanut butters were stabilized by incorporating into them a commercially hydrogenated peanut oil [m.p. *ca.* 64.5° C. (148° F.) and iodine value *ca.* 8] *(7)*, others by incorporating into them another commercial stabilizer, a pumpable, fatty suspension composed of equal parts of peanut oil, hydrogenated peanut oil, and salt *(8)*.

Samples and methods. Raw shelled peanuts, roasted shelled peanuts, germs, testa, sorted cotyledons, and peanut butters made from sorted cotyledons without additives (A), with added salt (B), and with added salt and stabilizer (C) were analyzed for moisture and oil contents. The oils extracted from these samples were analyzed for free fatty acids content.

The moisture contents of raw shelled peanuts, roasted shelled peanuts, sorted cotyledons, germs, testa, and peanut butter were determined essentially by the official method of the American Oil Chemists' Society for moisture and volatile matter *(1a, 6)*. The method is based on the loss of weight resulting from heating the sample at 130 ± 3° C. in a forced draft oven for 3 hours.

The oil contents of the raw shelled peanuts, the roasted shelled

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peanuts, and the sorted cotyledons were determined by AOCS Official Method Ab 3-49 *(1b)* for determining oil in shelled peanut stock. In this method a sample of approximately 2 g. is extracted with petroleum ether. Essentially the same procedure was used for determining the oil content of germs, testa, and peanut butter.

The free fatty acids in the oils extracted from the raw, intermediate, and finished products were determined according to AOCS Official Method Ab 5-49 *(1c)*.

RESULTS AND DISCUSSION

The oil in raw and roasted peanut kernels and the oil in roasted materials separated during the blanching and manual sorting operations is shown in Table 1, and the oil in peanut butters is shown in Table 2. The free fatty acids in oils from raw and roasted peanuts, from components separated during blanching and sorting, and from finished products are uniformly small. A diagram is shown in Figure 1 which indicates the variations in the content of oil and free fatty acids in peanuts during the manufacture of a typical batch of peanut butter.

Kernels. Calculated on an oven-dry basis the oil content of the roasted peanut kernels (Table 1) is about 0.7% higher on the average (20 batches) than the corresponding raw stock. Products 1 to 10, which represent very light to medium roasts, show increases of 0.1 to 1.3%; whereas products 11 to 20, which represent dark to very dark roasts, show increases of 1.2 to 2.7%. These differences in oil contents of raw and roasted peanuts are only apparent and presumably are occasioned by losses of volatile matter in addition to moisture *(6)* during roasting or to some effect of heat on the non-oil portion.

Components. The elimination of germs and testa during blanching, and objectionable material during sorting *(10)*, leaves material composed principally of cotyledons with approximately 0.9% more oil (Table 1) on the average (20 batches) than the corresponding roasted peanut kernels, both calculated on an oven-dry basis. The range of increases in oil content was from 0.3 to 1.9%. These increases are, of course, only apparent; they do not indicate an actual gain in oil. Separation of components of lower oil content are responsible. The average oil content of the roasted germs was about 47%. The average oil content of the testa was about 28%. This is an appreciably higher oil content than is reported by other investigators *(4, 5b)* and is likely the result of oil being absorbed by the testa during roasting and blanching *(10)*.

Peanut butters. The oil contents of peanut butters without additives, with only added salt, and with added salt and stabilizer are recorded in Table 2. In addition,

TABLE 1
Oil content (dry basis)

Batch No.	Kernels		Materials separated during blanching and sorting		
	Raw	Roasted	Germs	Testa	Sorted cotyledons[b]
	%	%	%	%	%
1	49.8	50.0	45.8	24.6	50.9
2	47.7	48.0	46.2	27.7	49.3
3	50.0	50.3	47.2	29.0	51.0
4	49.2	50.1	47.5	29.7	50.9
5	48.8	48.7	47.0	27.4	50.5
6	50.0	50.5	47.9	29.8	50.9
7	47.6	47.8	46.9	26.4	49.1
8	46.8	47.2	46.1	25.4	49.1
9	47.4	47.9	46.7	28.0	49.5
10	48.6	49.9	47.3	30.6	50.3
11	49.8	50.1	47.4	26.4	49.8
12	49.2	50.4	47.6	30.1	50.7
13	49.2	50.4	48.3	28.6	51.6
14	48.4	48.0	46.4	23.1	48.5
15	49.1	50.3	48.4	27.7	51.1
16	48.7	50.0	47.6	30.1	50.9
17	49.6	50.4	47.7	28.1	50.7
18	47.5	47.8	46.4	25.2	48.9
19	48.0	50.7	48.0	29.0	
20	48.2	49.5	48.2	31.4	51.3
Av.	48.7	49.4	47.2	27.9	50.3

[b] Used for production of peanut butter.

TABLE 2
Oil in peanut butter

Batch No.	(A) Containing no additives Oil content Oven-dry basis	(B) Containing added salt			(C) Containing added salt and stabilizer					Difference, fat content oven-dry, additive-free basis, (Type C-Type B)
		Salt content oven-dry basis	Oil content		Content of additives oven dry basis			Oil content		
			Oven-dry basis	Dry, salt-free basis	Salt	Oil	Stabilizer	Oven-dry basis	Oven-dry, additive-free basis	
	%	%	%	%	%	%	%	%	%	%
1	50.9	1.53	49.93	50.71	1.53	—	1.5[c]	50.68	52.27	1.56
2	48.6	1.53	47.70	48.44	1.53	—	0.9[c]	48.18	49.40	0.96
3	50.7	1.42	49.9	50.59	1.39	—	0.9[c]	50.4	51.54	0.95
4	50.7	1.42	50.6	51.37	1.42	—	0.8[c]	51.0	52.17	0.80
5	50.7	1.42	50.21	50.93	0.93[d]	0.93[d]	0.93[d]	51.35	52.81	1.88
6	50.6	1.41	50.13	50.87	1.39	—	1.2[c]	50.76	52.12	1.25
7	48.5	1.52	47.9	48.68	1.3[d]	1.3[d]	1.30[d]	49.4	51.33	2.65
8	48.3	1.52	47.76	48.50	1.3[d]	1.3[d]	1.3[d]	49.48	51.69	3.19
9	49.4	1.44	48.93	49.64	1.25	—	1.7[c]	49.88	51.40	1.76
10	50.6	1.26	50.07	50.71	1.23	—	0.8[c]	50.47	51.51	0.80
11	49.8	1.42	49.5	50.23	1.4[d]	1.4[d]	1.4[d]	51.0	53.26	3.03
12	50.7	1.39	49.97	50.67	1.3	—	0.3[c]	50.1	50.93	0.26
13	50.7	1.41	50.36	51.08	1.4	—	0.8[c]	50.77	51.94	0.86
14	48.8	1.50	48.3	49.06	1.5	—	0.9[c]	48.8	50.02	0.96
15	50.3	1.41	49.6	50.31	1.5[d]	1.5[d]	1.5[d]	51.2	53.73	3.42
16	50.7	1.41	50.3	50.97	1.38	—	0.97[c]	50.7	51.96	0.99
17	50.8	1.41	50.5	51.24	1.5[d]	1.5[d]	1.5[d]	51.8	54.06	2.82
18	48.6	1.51	48.1	48.83	1.2[d]	1.2[d]	1.2[d]	49.6	51.43	2.60
19	50.4	1.41	50.13	50.85	1.41	—	1.5[c]	50.89	52.41	1.56
20	51.0	1.51	50.5	51.26	1.4[d]	1.4[d]	1.4[d]	51.8	53.92	2.66

[c] A commercial grade of hydrogenated peanut oil [*ca.* m.p. 64.5° C. (148° F.) and iodine value of *ca.* 8].
[d] A commercial grade of peanut butter stabilizer composed of an equal weight mixture of salt, peanut oil, and hydrogenated peanut oil.

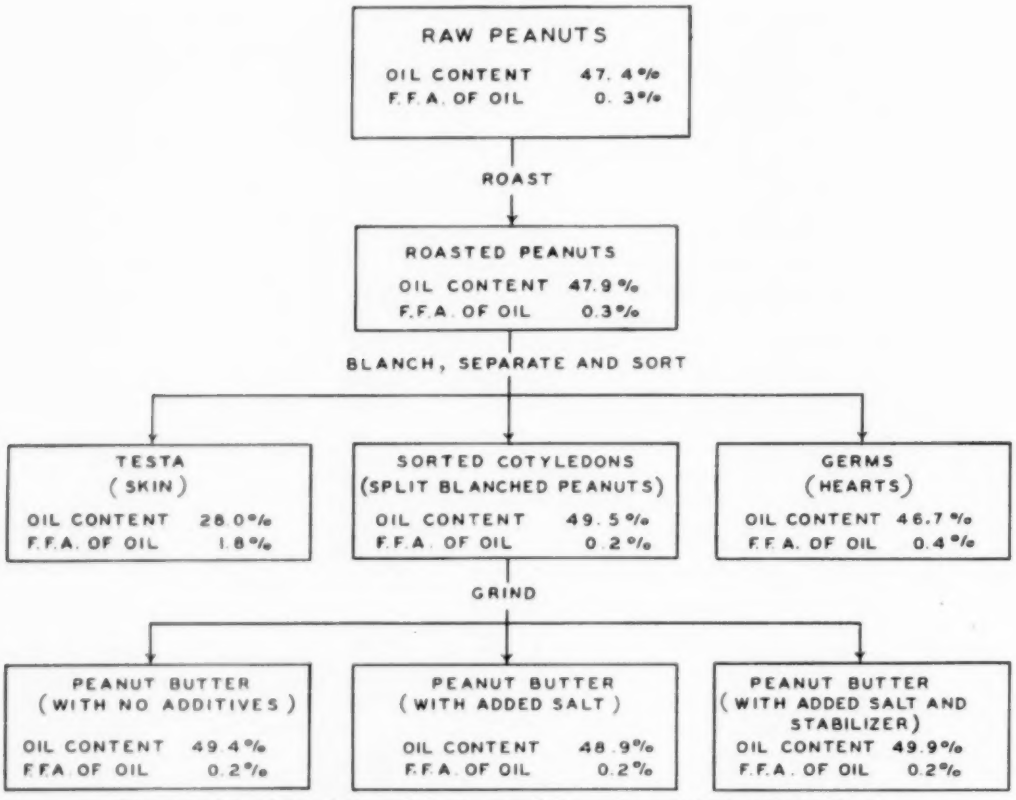

Figure 1. Oil and free fatty acids in the manufacture of peanut butter (Batch No. 9).

the increase of oil content of peanut butter resulting from incorporation of stabilizers is shown by comparison of the oil contents (oven-dry, additive-free basis) of peanut butter prepared with only salt added (type B) and of peanut butter with added salt and stabilizer (type C). For example, in batch No. 1 the oil content of the peanut butter stabilized by incorporation of about 1.5% of hydrogenated peanut oil was about 1.6% greater than the oil content of the peanut butter containing only added salt prepared from the same sorted cotyledons. Also, in batch No. 15 the oil content of the peanut butter, stabilized by grinding the sorted cotyledons with about 4.5% of a stabilizer composed of an equal weight-mixture of salt, peanut oil and hydrogenated peanut oil, was about 3.4% greater than the oil content of the peanut butter containing only added salt prepared from the same roasted peanuts. In this instance, about half of the increase in the oil content is produced by the peanut oil which is used as a carrier for the stabilizer, and the other half by the hydrogenated peanut oil. The same type of comparison may be made between the oil content of roasted cotyledons and the peanut butter containing salt and stabilizer made from such cotyledons. Analysis of representative samples of roasted cotyledons and the stabilized peanut butter made from roasted cotyledons affords peanut butter manufacturers an approximate means of determining the uniformity of incorporation of the stabilizer in the product.

Free fatty acids. It was ascertained that the steps in the manufacture of peanut butter do not occasion any troublesome free fatty acids content in the product. The free fatty acids of the oils extracted from raw peanuts varied from 0.1 to 0.6%, the average value (20 batches) being 0.33%. The values for the oils from roasted peanuts varied from 0.2 to 0.7%, the average being 0.3%. The sorted, roasted cotyledons yielded oils varying in free fatty acids contents from 0.2 to 0.4%, the average value being 0.25%. Slight decreases in contents of free fatty acids were generally noted as a result of roasting, blanching, and sorting, the average decrease being about 0.1%. This effect probably resulted in part from the slight loss of volatile matter which occurs during roasting, but to a greater extent from the removal of germs, testa, and other material during blanching and sorting. The average values for the content of free fatty acids of oils extracted from the germs and testa were 0.38% (range 0.2 to 0.6%) and 1.6% (range 0.8 to 3.1%) respectively.

Figure 1 shows that the testa and the germs, the materials eliminated during blanching and separating, are relatively low in oil content and relatively high in free fatty acids. The results of removing these materials are that the finished product is higher in oil content and lower in free fatty acids than the roasted peanuts. The effect of increase in oil content is to produce a smoother and less sticky product. Data from previous work *(10)* furnished information for calculation of a materials balance during the manufacture of peanut butter. In the manufacture of batch No. 9, 100 pounds of raw peanuts yielded 94.9 pounds of roasted peanuts,

which on blanching, separating, and sorting furnished 3.7 pounds of testa, 2.0 pounds of germs, 2.5 pounds of objectionable or extraneous material and 86.7 pounds of sorted cotyledons for grinding into peanut butter. By removal of the 3.7 pounds of testa and the 2.0 pounds of germs the free fatty acids content of the finished product was reduced by 30%, while the oil content was increased approximately 2%. These byproducts are a rich source of oil since the 5.7 pounds of testa and germs contain 2 pounds of oil (37%).

SUMMARY

Data have been presented on the effects of roasting, blanching, and sorting on the oil contents of raw peanuts, intermediates, and finished products used in the preparation of stabilized and unstabilized peanut butters.

The data indicate that the roasted peanut kernels have a higher oil content than the corresponding raw kernels. This difference results presumably from loss of volatile matter in addition to moisture during roasting or from some effect of heat on the non-oil portion of the peanut.

The data also show that the sorted cotyledons resulting from the elimination of germs, testa and objectionable material during blanching, screening, and sorting contain a higher percentage of oil than the roasted kernels. Separation of components of lower oil content is responsible for this difference.

The testa of raw peanuts generally contains a very low percentage of oil. On the basis of the high percentage of oil found in the roasted testa it may be concluded that the testa has absorbed oil that was exuded from the peanut during roasting.

Examination of data reveals that the free fatty acids contents of the oils extracted from raw and roasted peanuts, sorted cotyledons, and peanut butters prepared with and without additives were uniformly low. It may also be concluded from these data that the roasting, blanching, and manual sorting operations in the manufacture of peanut butter are responsible for the slightly lower free fatty acids content of the oil in the sorted cotyledons than that found in the oil of the raw peanut kernels.

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Non-Bacterial Reduction of Nitrite in Pork[a]

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Soluble materials extracted from pork interfere in the determination of nitrite. The error thus introduced into analysis of cured pork products is relatively constant for any one method of extraction. Because of dilution, the error is negligible in the analysis of used tank pickles.

The reducing systems of fresh pork caused a progressive destruction of nitrite which was independent of bacterial contamination. The loss increased as the pH decreased, and as the temperature increased up to the temperature of protein denaturation.

The oxidation-reduction potential of suspensions of pork was approx. + 225 mV. at pH 5.9, but the factors controlling Eh did not control the destruction of nitrite. Some intermediary electron carriers were necessary for the reduction of nitrite by the reducing compounds of the meat. Hemoglobin, and 2:6-dichlorobenzenone indophenol were both capable of supplementing the electron carriers and increasing the loss of nitrite. Ascorbic acid, which lowered the Eh of the suspension, had less effect on the loss of nitrite.

Nitrite, whether added directly or formed by reduction of nitrate, is essential for good color development in the curing of pork products, but because of its undesirable properties the amount present must be controlled within narrow limits. The amount of a curing salt added to meat can be controlled by curing procedure, but the amount of nitrite found in meat by analysis is not entirely dependent upon the amount added.

Much of the variation in nitrite content is caused by bacterial action *(9)*, but work on the pH of muscles *(4)* indicates that other factors have a marked effect on the nitrite content of cured samples. These factors probably include destruction of nitrite by reaction with meat constituents, binding of nitrite by meat proteins so that it is not extracted by the procedure used, and interference of other extractable materials with the final analysis. A

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study was, therefore, made of the effect of these factors on the apparent nitrite content of pork.

MATERIALS AND METHODS

Two and one-half g. samples of finely ground psoas muscle[b] were macerated with a small amount of water and diluted to about 30 ml. in a wide-necked 50 ml. volumetric flask (sugar inversion type). Ten ml. of McIlvaine's citric acid-sodium phosphate buffer was added and the suspension held overnight at 40° F. (4.5° C.). The mixture was then warmed to room temperature, 125 μg. of sodium nitrite and/or other test solutions added, and the volume made to 50 ml. with water. Control solutions were prepared without pork. Separate flasks were prepared for initial (0-hour) analysis and for analysis after a 5 hr. reaction period on an end-over-end rotor in an air oven at 110° F. (43° C.).

For nitrite analysis, suspensions were centrifuged and a 1:5 dilution of the supernatant was filtered through a Whatman No. 42, 15 cm. paper. Color was developed in 10 ml. of filtrate by the sulfanilic acid-α naphthylamine method of Rider and Mellon *(6)*. Blank determinations without sulfanilic acid were prepared for each sample.

Nitrogen determinations were made by a micro-Kjeldahl technique, and the total solids determinations by air-drying for 18 hours, at 220° F. (105° C.). Bacterial counts were made on proteose peptone-tryptone agar incubated at 80.6° F. (27° C.) for 48 hours. Dyes used for estimating oxidation-reduction potentials were: 2,6-dichlorobenzenone indophenol (E. K.), 0-cresol-indo-2,6-dichlorophenol (B. D. H.), and 1-naphthol-2-sodium sulphonate-indophenol (B. D. H.). All dye solutions were prepared by dissolving 100 mg. of dye in 250 ml. of distilled water. Alpha-naphthylamine hydrochloride (E. K.) was recrystallized *(6)*, all other reagents were reagent grade.

INTERFERENCE OF SOLUBLE PROTEINS

Provided no rapid reaction occurs, the extent to which nitrite can be recovered immediately after addition to proteinaceous solutions should indicate the degree of interference of these materials in the determination. As shown by the data of Table 1, recovery in gelatin solutions was decidedly low. Use of gelatin that had been treated with excess nitrite and precipitated and washed with acetone did not improve the recovery, indicating that if binding had occurred it was reversed by acetone but not by the acid (pH 2.5) used in the determination.

TABLE 1

Interference of gelatin in the determination of nitrite

Gelatin concentration	Nitrite added	Nitrite recovered	Apparent loss
%	μg./ml.	μg./ml.	%
nil	0.43	0.43	0
1.4	0.43	0.30	30.0
2.1	0.43	0.24	44.0
2.1	0.64	0.41	36.1
3.2 treated[c]	0.45	0.14	69.3

[c] Gelatin that had been mixed with excess nitrite, then twice precipitated and washed with acetone.

More probably, the apparent loss was caused by interference of the gelatin with color development during analysis.

Table 2 shows that recoveries in aqueous extracts of fresh pork were also low. Lower recoveries occurred in a cold water extract than in a hot water extract. Partial precipitation of the solids from the cold water extract by heating the mixture after the addition of nitrite increased the recovery by about 20%. This suggests that nitrite was not bound to the heat coagulable protein, and that the extra 20% loss in the cold extract was caused by interference. The non-heat coagulable extractives may firmly bind some nitrite, but it is reasonable to assume that most of the

[b] Most muscles were obtained 24 hrs. after slaughter of the pigs. Samples stored between tests were frozen and held at —40° F. (—40° C.). No detectable change in the properties under study occurred in several weeks at this temperature.

TABLE 2

Interference of pork extract in the determination of nitrite (Total volume 50 ml.)

Pork extract added		Treatment of mixture	Nitrite added	Nitrite recovered	% loss
Type[d]	Amount				
	ml.		μg./ml.	μg./ml.	
	nil	nil	0.60	0.60	0
	nil	Heated, filtered[e]	0.60	0.60	0
Hot	10	nil	0.75	0.70	6.3
Hot	20	nil	0.75	0.67	10.9
Hot	20	nil	0.38	0.34	10.1
Cold	25	nil	0.60	0.40	32.7
Cold	25	Heated, filtered[e]	0.60	0.52	13.3

[d] Hot extract prepared by macerating lean pork tissue in hot water, heating for 20 minutes, diluting tenfold, centrifuging, and filtering the supernatant. Cold extract was prepared in the same manner but with cold water and no heating. The hot extract contained 0.03% nitrogen and 0.28% total solids, pH 6.55; the cold 0.080% nitrogen and 0.57% total solids, pH 5.98.

[e] Heated, after the addition of nitrite, for 20 min. in a boiling water bath, then filtered.

apparent loss of nitrite from these solutions was caused by interference and not by destruction or binding of nitrite.

Attempts to reduce this interference by precipitation of the soluble protein were unsuccessful either because the precipitant itself prevented full color formation (trichloracetic acid), or because color developed in the blanks (ethanol, acetone).

NON-BACTERIAL DESTRUCTION OF NITRITE

Since it was not possible to obtain sterile muscle and to maintain aseptic conditions, the extent to which bacteria were responsible for reduction of nitrite was determined over a range of experimental conditions. The data of Figure 1, show that the effects of pH and of temperature on nitrite destruction did not parallel the effect on bacterial growth, and that bacterial numbers became negliglible below pH 5.0 or above 113° F. (45° C.).

Loss of nitrite from pork suspensions increased with increasing temperature (Figure 1) until denaturation became marked, as indicated by a "cooked" appearance of the suspended meat particles, then decreased sharply.[f] Over a five-hour period, denaturation was obvious at 120° F. (49° C.), but not at 110° F. (43° C.).

At 110° F., recovery of nitrite decreased with decreasing pH (Figure 1). Within the range pH 7.0 to 5.0 (Table 3) losses from control samples without pork were within the error of the analysis, and the 0-hour recoveries from the pork suspensions were essentially constant. Below pH 5.0, nitrite loss increased still further, but there was also a marked decrease in the 0-hour recovery, and below pH 3.5 an extensive loss of nitrite occurred from control samples. Thus, within the pH range 7 to 5, differences between 0 and 5-hr. recoveries are a reliable measure of the extent of the reaction, but may not be so at lower pH levels.

Because the most probable mechanism of nitrite destruction appeared to be reduction, the oxidation-reduction potential of the pork suspensions was estimated. Two and one-half g. of pork suspended in a volume of 50 ml. at pH 5.89 (buffer pH 5.5) reduced 2:6 dichlorobenzenone indophenol in 5 minutes, and 0-cresol-indo 2,6-dichlorophenol in 15 minutes, but did not reduce 1-naphthol-2 sodium sulphonate indophenol in 7 hrs. at 110° F. Since the E_{m}' of these dyes at pH 5.89 is 284, 248 and 190 mV. respectively, the Eh of the suspension was between 190 and 248 mV. The potential determined in this manner at 110° F. did not vary to a measurable degree with pH, but the total amount of 2,6-dichlorobenzenone indophenol that the meat could reduce in 5 hours at 110° F. (Table 4) decreased markedly with increasing pH.

[f] Heat denatured pork suspensions destroyed considerable quantities of nitrite at very high temperatures, e.g. at 250° F. (121° C.), with other conditions as outlined under "Methods," 44% of the nitrite was destroyed in 1 hr. [cf. *(8)* and *(5)*]. This destruction is probably caused by chemical reaction of nitrite with amino groups. A similar loss was observed in a 2.5% glycine solution.

TABLE 3

Effect of pH on the destruction of nitrite by suspensions of pork

Control samples				Pork suspensions			
pH	Nitrite recovery, %		Loss in 5 hr., %	pH	Nitrite recovery, %		Loss in 5 hr., %
	0 hr.	5 hr.			0 hr.	5 hr.	
3.17	96.6	80.0	16.6	3.17	33.8	9.4	24.4
3.52	100.6	91.4	9.2	3.39	42.2	8.0	34.2
4.02	99.1	96.6	2.5	4.10	73.5	26.6	46.9
				4.76	83.4	54.4	29.0
5.05	98.0	97.3	0.7	5.15	86.9	69.0	17.9
				5.68	87.2	76.6	10.6
6.09	98.7	98.0	0.7	6.20	86.0	75.8	10.2
				6.68	87.5	78.2	9.3
7.03	98.7	99.7	−1.0	7.13	86.9	81.0	5.9

TABLE 4

Amount of 2:6-dichlorobenzenone indophenol reduced by pork suspensions at various pH levels (2.5 g. pork in 50 ml., 0.1% dye solution)

pH	Ml. dye reduced during	
	2 hrs.	5 hrs.
5.55[a]	15	17
5.83	10	12
6.38	7	7
6.62	2	4

[a] Lower pH levels were not studied because the dye is pH sensitive.

Suspensions of meat that had been cured in a Wiltshire type pickle failed to reduce any of the dyes, and there was no loss of nitrite when the suspensions were held at 110° F. for 5 hr. The effect of curing salts on the potential was therefore investigated. Salts were added to the suspensions and the mixtures held at 40° F. (4.5° C.) overnight before addition of dye. As shown by Table 5, neither sodium chloride nor sodium nitrate significantly affected the rate of dye reduction, but 100 p.p.m. of sodium nitrite decreased the rate slightly and 500 p.p.m. raised the potential sufficiently to prevent reduction of the dye. Overnight exposure to nitrite apparently destroyed, or completely oxidized, the systems responsible for nitrite reduction.

No relation was found between the ability of fractions to reduce dye and their ability to destroy nitrite. Soluble and insoluble fractions of centrifuged pork suspensions each destroyed about half as much nitrite as the complete suspension. For example, when nitrite loss from entire suspension was 19.7%, losses from the soluble and insoluble portions were 8.7% and 9.4% respectively. The nitrite loss of the whole suspension was

TABLE 5

Effect of curing salts on the reduction of dye by pork suspensions at 110° F. (43° C.) (2.5 g. pork plus salt and buffer equilibrated 18 hr. at 40° F. (4.5° C.), 2 ml. of 2:6-dichlorobenzenone indophenol added, and volume made to 50 ml.)

Salt added	pH of suspension	Time for complete reduction of dye
None	5.87	10 min.
15% NaCl	5.10	5 min.[b]
1% $NaNO_3$	5.71	10 min.
100 p.p.m. $NaNO_2$	5.88	15 min.
500 p.p.m. $NaNO_2$	5.90	More than 24 hr.

[b] The decrease in pH of this solution was sufficient to account for the rapid reduction.

decreased by heating to only 3.7%. On the other hand, the potential of the fractions, and of the heated suspension, remained at approximately 225 mV., and the amount of dye destroyed in 5 hrs. was not altered.

Pork suspensions that had been equilibrated with 500 p.p.m. of nitrite for 18 hours, failed to reduce 2,6-dichlorobenzenone indophenol (Table 5). However, when nitrite and 2:6 dichlorobenzenone indophenol were added together the dye considerably increased the loss of nitrite (Table 6). Furthermore, the dye was capable of at least partially replacing those portions of the nitrite destroying system which were inactivated by heat. Destruction of nitrite by the suspensions must, therefore, have been limited by some compound(s) capable of transferring electrons across the gap in potential between the nitrite-nitric oxide system (+650 mV.) and that of the meat (+225 mV.).

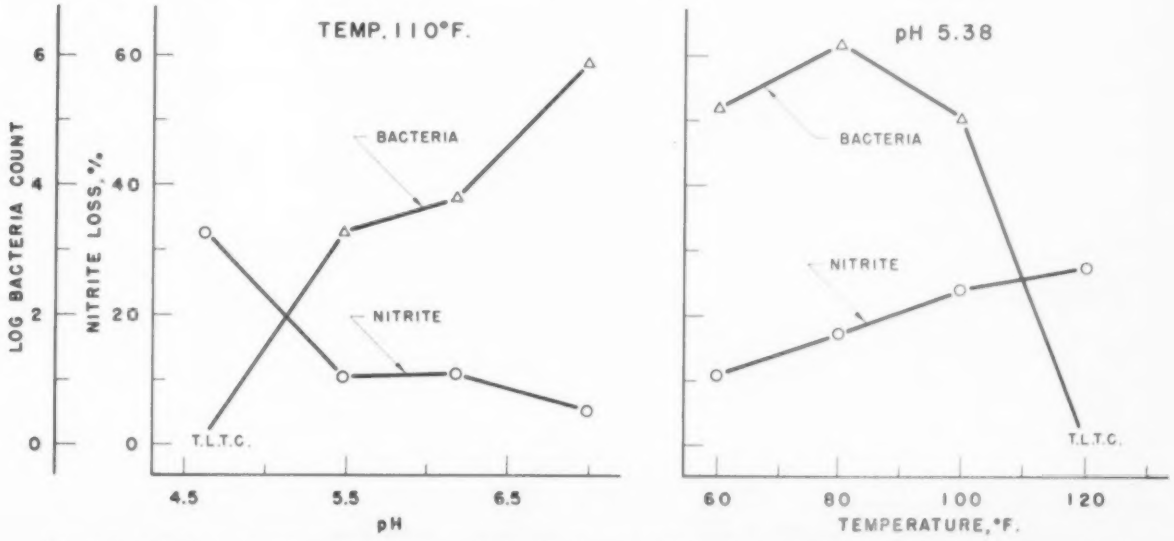

Figure 1. Effect of pH and of temperature on the destruction of nitrite and the growth of bacteria in pork suspensions.

TABLE 6
Effect of 2:6-dichlorobenzenone indophenol, oxyhemoglobin, potassium cyanide, and ascorbic acid on destruction of nitrite by pork suspensions (pH 5.8 to 5.9, 125 μg./50 ml. total volume)

Suspension	Reagent added	5 hr. loss of nitrite, %	
		Suspension only	Mixture
2.5 g. pork	13 ml. 2:6-dichlorobenzenone indophenol[1]	12.2	21.2
Pork solubles only	13 ml. 2:6-dichlorobenzenone indophenol[1]	7.8	17.0
Heated pork	13 ml. 2:6-dichlorobenzenone indophenol[1]	3.0	14.6
2.5 g. pork	13 p.p.m. KCN	10.2	5.2
2.5 g. pork	650 p.p.m. KCN	10.2	2.6[8]
2.5 g. pork	1 ml. oxyhemoglobin[2]	9.0	38.4
2.5 g. pork	2 ml. oxyhemoglobin	9.0	56.0
2.5 g. pork	1 mg. ascorbic acid	10.6	18.6
2.5 g. pork	10 mg. ascorbic acid	12.4	19.6
2.5 g. pork	1 ml. oxyhemoglobin plus 1 mg. ascorbic acid	10.6	62.8
Water	1 mg. ascorbic acid		16.2[4]

[1] 0.04% solution. The dye was not completely reduced by any of the suspensions.
[2] 1 to 1.5 mM. hemoglobin/litre.
[3] pH of mixture 6.43.
[4] Initial recovery 87.2%, 5 hr. recovery 97.4%.

The most probable carrier in this range would be a ferric-ferrous system, and the effects of cyanide and of added hemoglobin were therefore tested (Table 6). Potassium cyanide, at a concentration of 13 p.p.m., had a significant inhibitory effect, while 650 p.p.m. reduced the loss of nitrite to that found with heat-denatured suspensions. Added hemoglobin markedly increased the destruction of nitrite.

Combinations of hemoglobin and ascorbic acid, which lowers the Eh of the suspensions, were also studied (Table 6), but interpretation of the results was difficult because of lower recoveries in control mixtures of ascorbic acid and nitrite at 0 time than at the end of the 5-hour reaction period. However, it is evident that the destruction of nitrite was increased less by ascorbic acid than by the addition of either 2:6-dichlorobenzenone indophenol or oxyhemoglobin. Thus, in the destruction of nitrite, the electron transfer systems in the 650 to 190 mV. range were more limiting than the actual potential.

DISCUSSION AND CONCLUSIONS

Data presented in this paper suggest that the reported nitrite contents of bacons and hams analyzed by the sulfanilic acid—α naphthylamine method have been in error because some extractable materials interfere with the determination. Any one method of extraction should give solutions having relatively constant interference, and comparisons between samples analyzed by the same method should therefore be reliable. Data obtained by different extraction procedures may not be comparable. Used tank pickles also contain pork extractives, but most pickles require extensive dilution before analysis and the error is therefore minimized.

The destruction of nitrite by reducing systems in the meat probably affects the final nitrite level of the meat significantly. Under the conditions used, these systems were capable of destroying 10 μg. of nitrite per gram of meat in 5 hr. at 110° F. and up to 30 μg. in the presence of added hemoglobin. Even assuming that the experimental procedure did not decrease the activity of the systems involved, extrapolation of the temperature curve in Figure 1 to 40° F. indicates that a significant portion of the nitrite added to meat would be destroyed by the reducing systems during a normal 3 to 7 day cure. In accelerated cures less nitrite would be destroyed and the amount added should be reduced.

The potential of the pork suspensions used in these studies was between 190 and 250 mV. at pH 5.89. Hemoglobin and myoglobin present in the suspensions would be in the met- form [Eh of methemoglobin + 160 mV. at pH 7.0 *(3)*] and the chromogenic reactions involving hemoglobin and nitrite would differ from those occurring in meat. However, it is reasonable to assume that the effect of comminution and dilution has been to increase the availability of oxygen and thus raise the potential some 400 mV. [Eh of pork —200 mV. *(2)*] towards the positive side without changing the systems involved.

The measurements of oxidation-reduction potentials made in dilute suspensions were not sufficiently sensitive to indicate differences in the potential at different pH levels, but the total amount of dye reduced in 5 hr. increased markedly with decreasing pH, thus paralleling the destruction of nitrite. However, the data on heated suspensions indicated that there was no direct relation between the reducing capacity towards dyes and towards nitrite. The ability of the suspensions to reduce dyes appeared to be controlled by various heat-stable components of the meat, while the reduction of nitrite was limited by some unknown, heat labile intermediaries.

From a practical point of view, these findings indicate some of the factors affecting the formation of nitric oxide hemoglobin. Although hemoglobin may react directly with nitrite to give a mixture of nitric oxide hemoglobin and methemoglobin *(1)* the relatively rapid reduction of nitrite suggests that hemoglobin will more probably react directly with nitric oxide. Since the amount of nitrite reduced increases with decreasing pH, the rate of color formation should be greater in muscles from rested or fed animals *(4, 7)*, and the lower residual nitrite in these muscles may be a factor in the greater color stability *(4)*. The limiting factor in the rate of nitrite reduction appears to be some intermediary electron carrier rather than the overall reducing potential. The artificial lowering of the potential by ascorbic acid, etc. can thus be of only limited value.

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Consistency Evaluation of Dehydrated Potato Granules and Directions for Microscopic Rupture Count Procedure[a]

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Consistency of rehydrated mash as related to quality evaluation of precooked dehydrated potatoes is discussed. The complicating factor in laboratory tests which are intended to measure some function of consistency is presented. The method of consistency evaluation by direct observation of individual plant cells is discussed and specific directions as well as statistical treatment for carrying out this method are included.

Several precooked and dehydrated potato products which rehydrate rapidly to give a mashed potato ready for table serving have been described *(1, 7, 12, 18)*. Laboratory evaluation to anticipate consumer acceptance of a dehydrated potato product is a challenge. The consumer, of course, is the final judge on any food product. It is believed that the food is judged by the consumer, in a subconscious manner, on numerous factors including such items as general appearance, color, taste, and the way the food feels in the mouth.

Mouth-feel plays an important role in an individual's acceptance of this food. This paper divides mouth-feel into two parts—texture and consistency[b]—but deals primarily with consistency.[c] Apparently one desires a mouth-feel similar to that with which he is familiar. If potatoes are gritty or like sand, or if they are mushy or pastry, they will not be accepted.

Causes for variable consistency. At least 2 general concepts of reasons for variations in consistency exist. In brief the first concept holds that a retrogradation of the amylopectin (a straight chained starch molecule) to amylose (a branched chain structure) takes place under certain holding conditions and that this change results in a starch molecule which is not sticky *(1, 17, 19)*. This concept, as applied to dehydrated potatoes, does not seem to be clearly developed or established.

The second concept holds that a rupture of the plant cell wall results in release of the "free" starch from the plant cell with a resultant poor consistency *(13, 18)*. This concept has been investigated and has been found to be valid *(10)*. Confirmation of the second concept, however, does not show that the first concept is invalid nor does it show that there are no other factors which may contribute to the changes in consistency.

This paper will discuss (a) various methods which have been proposed for the laboratory evaluation of rehydrated potato consistency, (b) the reason why none of these methods can be truly accurate and (c) specific directions for use of one method which can be used on certain kinds of products.

Methods of evaluation. Numerous methods have been proposed to evaluate consistency. Among these are: (a) taste panel, (b) direct observation of the rehydrated mash, (c) viscosity of the mash, (d) viscosity of the liquid separated from the rehydrated granules by centrifugation or filtration *(2)*, (e) analysis of starch content of decanted rehydration liquid *(18)*, (f) weight of quantity of potatoes adhering to a standard glass surface after the surface has been dipped into the rehydrated mash, (g) tensile strength of puddled, rolled, and dried material, and (h) observation of cells under a microscope with direct counting of individual cells.

The complicating factor. One factor which contributes greatly to the difficulty of evaluating consistency is the variance in the proportion of the intracellular substances which are extruded from the cell. This may be explained by a study of photomicrographs of cells in Figure 4. Each of the cells, E, F, G, and H is ruptured. When measured on an area basis, it is seen that 45% of the contents of the cell E, 9.5% of F, and 25% of H has been extruded. It is possible that all of the ruptured cells in a given product will have only a small part of their intracellular substances extruded (Cell F). Another product with the same percent of ruptured cells may have all of the ruptured cells with a high portion of their individual intracellular substances extruded (Figure 4, Cell E).

Thus, it is apparent that any evaluation method which is based on measurement of quantity of intracellular substance which has been transferred to the outside of the cell cannot be used to measure the percent of ruptured cells unless a means is devised to provide for the removal of a uniform portion of intracellular material from every ruptured cell. It is probable that any attempt to extrude a uniform percent from each cell would be difficult to achieve. Variation in temperature of rehy-

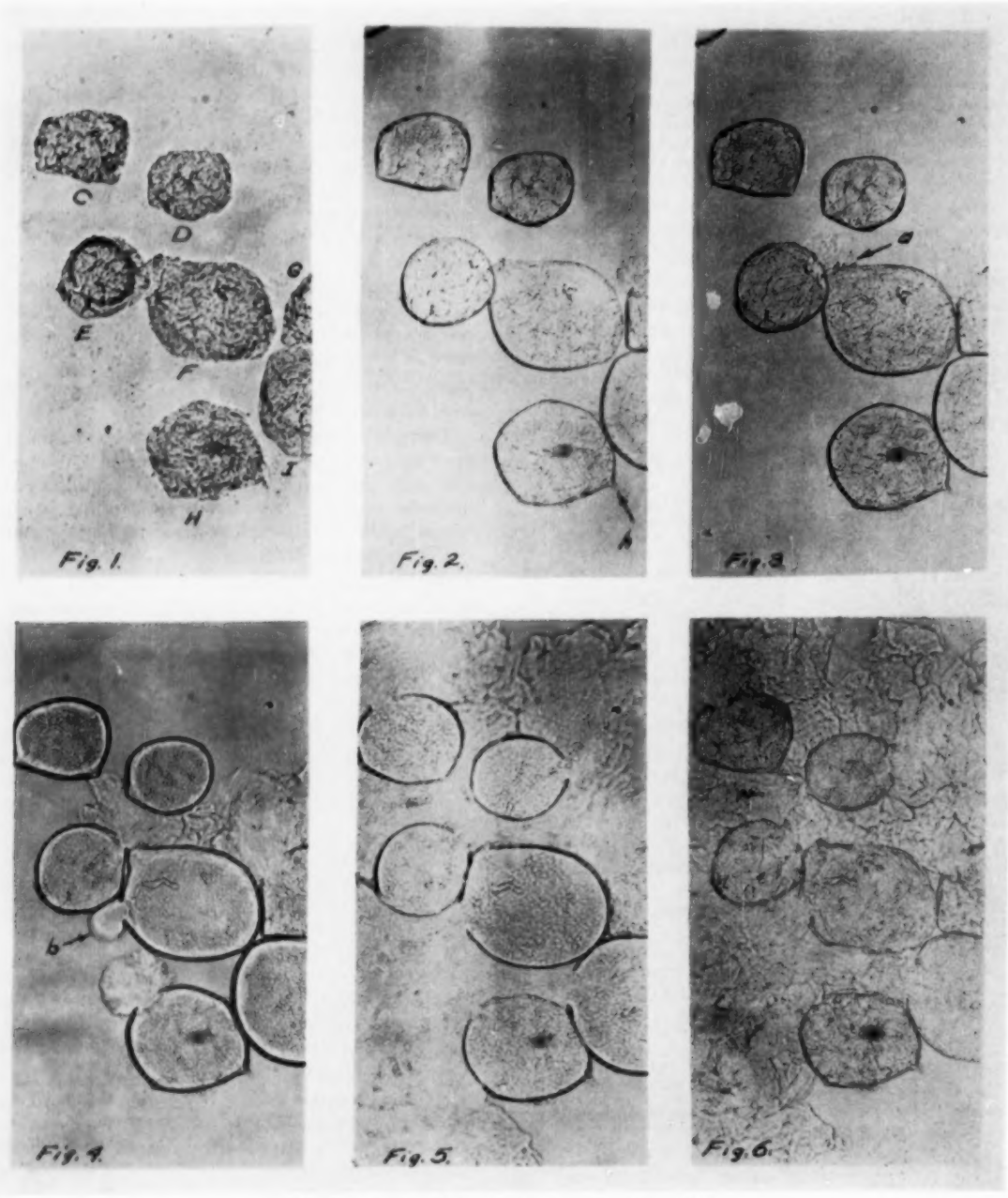
[a] Contribution No. 3, Department of Chemical Engineering and Contribution No. 10, Statistical Laboratory, Kansas State College, Manhattan.

[b] Webster defines *texture* as: " . . . the characteristic disposition or connection of threads in woven fabric or the disposition or manner of union of the particles of a body or substance . . . " and *consistency* as: " . . . a condition of adhering together, firmness, coherence or a degree or firmness, density, viscosity, or the like . . . " Wagner *(25)* refers to texture as " . . . the grain or smoothness of the rehydrated product . . . " and to consistency as " . . . the degree of stickiness or gumminess. . . . " It thus appears that the term *texture* has come to mean how hard or how soft as well as how large or how small the individual grains or kernels in the mass of rehydrated food actually are. If the individual kernels are large and hard the texture is said to be grainy or gritty. If the individual kernels are small and soft the texture is said to be smooth.

[c] *Consistency* has come to refer to the condition of the individual kernels cohering together and adhering to foreign substances, that is the stickiness, gumminess, or viscosity of the rehydrated food. If the rehydrated product is sticky and highly viscous it has a poor consistency. If it is firm in body but not viscous or sticky it has a good consistency.

dration water, method, and time of mixing, and time of standing all could contribute to changes in the fraction extruded. Mechanical manipulation aimed at removing all material from the ruptured cells would probably be so rigorous that additional cells would be broken.

If, for example, the potatoes were prepared by whipping, with either a hand fork or an electric beater, one cell might be struck a light blow and its response would be similar to the results of Figure 3 where but little extruded starch is shown. Another cell might be struck a harder blow and its response would be simliar to the result of Figure 4, where more starch is forced out of the cell than in Figure 3. Still a third cell might be struck a heavy blow and its response would be similar



Figures 1 to 6. Photomicrographs of potato cells.[4]

[4] Slides were prepared by suspending rehydrated cells in an excess of water, placing a drop of the resulting suspension onto a glass microscopic slide and staining with iodine. A second slide was then placed on top of the first, thus sandwiching the cells between the two. The cells were then brought into focus and pressure applied to the top slide. Figure 1 was taken with no pressure applied. Figures 2, 3, 4, and 5 were taken of the same cells but with increasing values of pressure. Figure 6 was taken after the pressure had been released.

Scale: Cell E (see Figure 1) measures about 0.10 to 0.13 millimeters in diameter.

to the results indicated by Figure 5 where it is clear that many cells have been severely ruptured. Since characteristics of the plant cells, including size and strength of walls *(26)* vary with potato variety, growing conditions, and other factors of this nature, any standardization of items such as time, temperature, and *water : solid* ratio used in the rehydration procedure would not insure uniformity of fraction extruded from each cell.

The direct counting method. It may be observed that all of the 8 methods mentioned above for evaluating consistency, except direct microscopic count, are dependent upon the portion of the intracellular substances which is extruded and removed to the outside of the cell wall.

For certain types of experimental investigations, it is necessary to work with very small quantities *(9)*. This may result in having only a few cells available for examination. Under these conditions the method of direct observation by counting under the microscope is the only known method of analysis.

For these reasons considerable effort has been exerted toward developing the microscopic count method of evaluation.

The more common objections to the microscopic count method are: (a) It is slow and tedious. (b) For the untrained person, it is difficult to distinguish between the ruptured and the unbroken cells.[e] (c) If the percent of the cell rupture is high (about 20%) the resultant debris introduces so much confusion that even an experienced worker has difficulty making an accurate count. (d) In the feed-back process[f] the recycle portion may contain considerable material which has been released from the inside of the cells. In the subsequent mixing etc., this released material may coat the surface of the unbroken cells. As a result, a cell may appear unbroken under the microscope even though it is coated with a sticky material and consequently would not form a good mash upon rehydration. (e) The number of ruptured cells does not necessarily indicate the percent of extrusion from within the cells for the mass as a whole.

Nevertheless, the method can be reasonably reliable and is a useful tool in the hands of a trained technician. As a general statement, products having a rupture percent greater than 15 or 20 will not be accepted by the consumer as good food *(7)*; hence, evaluations beyond this figure are of little practical interest. For processes where no recycle stock, or only a small amount of recycle is employed, the complication resulting from released material adhering to the walls of non-ruptured cells is of relatively minor significance. Such processes are outlined by Greene and others *(8)*, by Birdseye *(3)*, by Barker *(1, 2)*, by Rivoche *(21)*, by Kaufman and others *(13)*, by Willetts and Rendle *(26)*, by Musher *(16)*, and by Volpertas *(23)*. Furthermore, the number of ruptured cells is a direct measure of how bad the consistency can get if total extrusion occurs on all ruptured cells.

[e] For example, in Figure 2 cell H appears to be broken at point h and, in Figure 3, cell F appears to be broken at point a. However, Figure 4 demonstrates that the point h was not a break and that cell E instead of cell F had broken at point a.

[f] In some dehydration processes *(6, 18, 20, 24)* the initial reduction in moisture content is accomplished by mixing previously dried material with wet. This is known as the feed-back process.

PROCEDURES

Procedure for microscopic count. It is somewhat difficult to determine who was the first to use this method of analysis. Greene and others *(7)* used it in their work. In 1933 Bunimovitch and Faitelowitz *(4)* refer to its use in their work. These investigators referred to the count in a general way only and did not give specific directions for making the count nor did they give references for such directions.

Work was undertaken to develop specific directions for conducting the microscopic count method of analysis. Directions presented here are the results of trial and error efforts and the recommended procedures are those which have been worked out over a period of some 2 years' use in laboratories in the Chemical Engineering Department, Kansas State College.

Actual procedures for the microscopic count are simple. A small quantity of the cells to be examined is placed in a test tube. Boiling water is added quickly and the contents stirred. A drop or two of the resulting suspension is placed on a microscope slide, some iodine stain added, and the specimen is ready for counting.

Sampling. It is necessary that the sample be representative of the mass. Since the very nature of many dehydration processes (including stirring and granulation with subsequent handling in dryer equipment) normally results in extensive mixing, hand-grab samples should be adequately representative in most cases. If doubt as to homogeneity exists (for example, products from tray-drying operations) provision must be made to insure truly representative sampling and mixing. Care must be exercised to avoid excessive grinding of granules: the cells of the dry granules may be shattered by rubbing between 2 surfaces.

Sample size. Some of the sample is placed into a pyrex (20 x 150 mm.) test tube. (With dry material enough cells to fill the hemisphere of the test tube bottom usually will be adequate; wet material will require more.) For special studies where limited sample quantity is available the rehydration may be made on only a few cells. After water is added to the sample, swelling will result *(14)*. Normally the depth of the rehydrated sample in the bottom of the tube should not exceed 1.5 cm. As experience is gained, the technician will be better able to judge the size of the sample to be placed into the tube.

Rehydrating. A uniform rehydrating water temperature should be employed. Water temperatures below about 60° C. (140° F.) often result in poor separation of the cells; they may tend to remain in groups or conglomerates which are difficult to count. As the temperature of water is increased, it is normal for the rupture count to increase. As a standardization for rehydration temperature, boiling water is used. This results in maximum visual observation of rupture to all cells. Boiling is a convenient temperature point. For a given locality it is adequately uniform and is easily maintained.

Boiling water from a suitable flask or beaker is poured into the test tube which contains the dry sample until the tube is half full. The container of boiling water should be kept over the flame while pouring into the test tube. Allow the test tube to stand until cool. It has been observed that rupture counts do not change if they are held for several days at low temperature (just above freezing), thus the prepared sample may be allowed to stand several days in a household refrigerator before the rupture count is made. If cells are frozen, they may appear wrinkled after thawing. This condition may be removed by warming to about 60° C. (140° F.) *(11, 14)*.

Preparation of slide. The standard glass microscopic slides should be freshly cleaned.[g] The test tube, containing water and rehydrated granules is stoppered and shaken vigorously. Shaking in this manner results in a better breakdown of the granules into single cells. After shaking, care must be exer-

[g] Excellent results may be obtained by washing the slides in soap and water, rinsing, and dipping them into a solution of Bon Ami. The slides are then placed in a rack and wiped clean with a soft, lint-free cloth immediately before use.

cised to see that all cells adhering to the test tube wall above the level of the water are washed back into the water.[h] Insert the dropper[i] into the suspension. Allow a drop to form on the dropper and touch it to the center of the clean slide. Add 2 drops of staining solution[j] on top of the first drop of cell suspension. Tip the slide back and forth and from side to side in such a manner as to cause uniform distribution of individual cells over a large portion of the glass slide surface.[k]

Making the count. A microscope with a movable stage is needed. A magnification of 75 x is adequate. Each cell must be studied individually. Count cells from one to 100 and record the ruptured cells.

Size of cell count. In general it will be found that 4 counts of 100 cells each will nearly cover the average slide prepared according to the preceding directions. As a general rule, therefore, no more than 400 or 500 cells should be counted on any slide.

The number of cells to be counted will depend upon the accuracy desired, the percentage of ruptured cells, and on the difficulty of distinguishing between ruptured and nonruptured cells.

Statistical treatment. After a count of the ruptured cells in a sample has been made, it is necessary to place lower and upper limits on the true percentage of ruptured cells in the product sampled, and to state what confidence can be placed in these limits. This is done by means of confidence intervals. The degree of confidence (or faith) which one has in the belief that a confidence interval includes the true percentage, p, of ruptured cells is included in the description of that interval. For example, if one uses a 95% confidence interval (CI_{95}), there are 95 chances in 100 that when this interval is obtained it actually will include p. Ninety-nine per cent intervals also are in quite common use, but the discussion in this paper will be confined to 95% confidence intervals. [See Snedecor *(22)* for more general discussion.]

The process of determining confidence intervals of the sort needed here has been simplified greatly by Clopper and Pearson *(5)*. With the aid of their graphs, the material of Table 1 for CI_{95} was derived. The X stands for the number of ruptured cells observed in the sample of n cells studied under the microscope.

Suppose that a sample of 30 cells has been observed under the microscope and 3 ruptured cells were seen, what can be concluded regarding the true percent (p) of ruptured cells in the product so sampled? Clearly, the true percent is not 10 just because 10% of the cells in this sample of 30 were ruptured. The next time 30 cells were inspected in a sample there might be 5, 2, or none ruptured; or any other number up to 30. By Table 1, the 95% confidence interval is seen to be 2 to 27% because $n = 30$ and $X = 3$. There are 95 chances out of 100 that this sample interval includes the p, which we wish to estimate. Obviously, this interval is so long that one could guess as well. This merely means that there is no hope of obtaining a useful result with such a small sample.

TABLE 1
Ninety-five percent confidence intervals

Number[l] ruptured X	Size of sample (n) 30	Fraction observed X/n	Size of sample n 100	250	1000
0	0 to 12	0.00	0 to 4	0 to 2	0 to 0
1	0 — 18	0.01	0 — 5	0 — 3	0 — 1
2	1 — 21	0.02	0 — 7	1 — 5	1 — 3
3	2 — 27	0.03	1 — 8	1 — 7	2 — 4
4	3 — 32	0.04	1 — 10	2 — 8	3 — 6
5	5 — 35	0.05	2 — 11	2 — 9	5 — 7
6	7 — 39	0.06	2 — 12	3 — 10	5 — 7
7	10 — 42	0.07	3 — 14	4 — 11	6 — 9
8	12 — 46	0.08	3 — 15	5 — 13	6 — 10
9	15 — 50	0.09	4 — 17	6 — 14	8 — 11
10	17 — 52	0.10	5 — 18	7 — 14	8 — 12
		0.11	5 — 19	7 — 16	9 — 13
		0.12	6 — 21	8 — 17	10 — 14
		0.13	7 — 22	9 — 18	11 — 16
		0.14	8 — 23	10 — 19	12 — 17
		0.15	8 — 24	11 — 20	13 — 17
		0.16	9 — 25	11 — 21	13 — 18
		0.17	10 — 26	12 — 22	15 — 19
		0.18	11 — 27	13 — 23	16 — 21
		0.19	12 — 29	14 — 25	17 — 22
		0.20	13 — 29	15 — 26	18 — 23

[l] The X stands for the number of ruptured cells observed in the sample of n cells studied under the microscope.

If a sample of 250 cells had been examined and 10% had been found to be ruptured, the 95% confidence interval is found to be 7 to 14, a much more useful interval. If 15 is the upper limit for an acceptable product, this result would give one considerable reason to believe that the product which was sampled would meet the standard.

Two decisions must be made before a confidence interval is obtained. One is: What risk of an error should be taken, realizing that the less the risk you wish to accept the wider the confidence interval and hence the less useful it is? The other decision is tied to the first. How short an interval must one have before it is useful? Should it be no more than 10 units long? No longer than 5? When someone says he wants to obtain the result within 5%, he actually is asking the impossible but may be satisfied with a confidence interval 10 units in length. If so, one needs to do two things before deciding upon the size of the sample. One is to make an intelligent guess about the neighborhood within which the true percent of ruptured cells probably lies. The other is to look at Table 1 and learn how large n must be for that neighborhood to keep the length of confidence interval at or below 10. To illustrate, if the true percent, p, is thought to be around 10, the CI_{95} for $n = 100$ is 13 units long (5 to 18) at 10, is 13 units long at 9, and is 14 units in length when $X/n = 0.11$; hence $n = 100$ is too small. At $n = 250$, the confidence intervals around $X/n = 0.10$ vary from 7 to 9 units in length. Hence $n = 250$ is an adequate size of sample, or a bit large. If it were especially advantageous to reduce sample size as much as possible, n probably could be reduced to 225 without danger of exceeding the specified length of interval.

These directions are based on the assumption that the cells will be either clearly ruptured or not ruptured. Since the decision as to whether or not the cell is ruptured must be made by the individual making the count, an unknown and uncontrollable factor is introduced. The magnitude of influence of this personal factor can be reduced by using a trained and experienced technician who has no personal interest in the results.

SUMMARY

The laboratory evaluation of "mouth-feel" of dehydrated potatoes is complicated by the variable portion of material which is extruded from an individual plant cell. The proportion extruded is nearly an uncontrollable factor. Direct counting of the cells under a microscope appears to be a practical approach to solution of the problem, provided the cells are not exces-

[h] There is evidence to indicate that cells may rupture upon rehydration after they have dried on a wall. In order to prevent overfilling of the test tube with wash water, subsequent stirring should be made with a long tube. A long eye dropper serves well as a stirrer.

[i] Satisfactory dropper may be made from 8 mm. pyrex tubing by drawing one end to about 4 mm. outside diameter and cutting to length of about 20 cm. Insert the small end into the suspension and close the open end with the index finger.

[j] Staining solution prepared as follows:

Soln. 1. 20% glycerine (20 ml. glycerine plus 80 ml. distilled water).

Soln. 2. Iodine solution [0.05 gm. iodine plus 0.02 gm. (potassium iodide or KI) plus 15 ml. water]. This solution should be placed in a smoked bottle and covered with dark paper.

The staining solution is made by adding 5 drops of solution 2 to about 4 ml. of solution 1. Vary this strength as desired for intensity of cell stain.

[k] It is desirable to get the specimen spread as thinly as possible in order to minimize the need for excessive focusing when going from one cell to another. This is difficult to accomplish if the slide is not clean.

sively coated with material which has been extruded from other cells. Statistical analysis adds objectivity to this method.

The direct counting method is being used by research workers who are studying the mechanisms of cell rupture, the factors which contribute to cell rupture, and methods for prevention of cell rupture.

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A Non-Destructive Method for Determining Microleakage in Commercial Glass Containers[a,b]

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High voltage gaseous discharge phenomena have been employed for the measurement of vacuum levels in commercial glass containers. The described method is especially adaptable to the purpose of relatively rapid, accurate determination of gas leakage rates.

The glass jar and metal can are to date the only containers commercially used for wet-pack, heat-processed foods. Each container type offers some advantages and disadvantages to its user. This paper is concerned, primarily, with two defects peculiar to glass containers—(a) graded discoloration of the food and (b) cap failure via the corrosion route. Graded discoloration, a non-uniform color change which develops in the food upon storage of the finished product, is generally manifested by a visible darkening which is at a maximum at or near the headspace food surface. The off-color thus produced becomes progressively less with depth in the container. The presence of oxygen in the headspace is generally conceded to be one of the determining factors in graded discoloration. Cap corrosion, i.e., corrosion of the metal components of the cap, results in defects known to the industry as "pitting," "pinholing," and "perforation." Cap corrosion is also known to be related to oxygen levels in the headspace.

Although the end effects of cap corrosion and graded discoloration are easily noted, and though oxygen is known to be a major factor in each, the actual reaction mechanisms and routes are still relatively ill defined. A partial list of the complicating factors would include (a) the presence of electrolytic potentials between the various materials (rubber, glass, enamel, product, metal) present; (b) type and weight of tin plate; (c) adhesion, porosity and reactivity of the enamel on the tin plate; (d) physico-chemical properties of the alloy iron base; (e) chemistry of the food itself, (f) jar and cap geometry, etc. In consideration of the facts that the major independent variable is oxygen, that gaseous diffusion of atmospheric oxygen is known to take place through the cap in the vicinity of the gasket and that many of the complicating factors mentioned are dependent for their effects on the presence of moisture, the desirability of developing a method for the measurement of gaseous microleakage into sealed, clean and dry, glass containers was manifest. It is recognized that data

[a] Patent pending.

[b] Presented before the Thirteenth Annual Meeting of the IFT Boston, Massachusetts, June 24, 1953.

obtained by such a method will not give a complete picture of cap and jar quality; it will, however, throw light on the role of gaseous diffusion in the leakage problem.

The basic principle that the minimum electrical field strength (voltage) necessary to maintain an electrical discharge in a gas is a function of the gas pressure has been known for well over 50 years. Intensive treatment of the subject can be found in several texts *(1, 2, 3)* and in numerous scientific papers. Both the apparatus required to produce it and the effect are simple to understand, but the theory and its associated mathematical background is quite complex. Container shape, volume and material, electrode shape, material and placement, gas composition and pressure, ambient temperature—these are among the more important factors influencing gaseous discharge phenomena.

If glass jars and their associated closures of a single design and size are considered, some of the foregoing factors become constant for that particular design and size. Further, if the enclosed gas is limited in composition (air) and if the ambient temperature is kept constant, characteristics of the glow phenomenon will be directly related to the degree of container vacuum. The comparison of containers of known vacuum with others in which the vacuum is unknown then becomes possible and is the basis of the method which is described in this paper.

EXPERIMENTAL

Apparatus. Two assemblies are required—the first for the purpose of evacuating and capping jars under known pressure conditions and the second for measurement of vacuum within the sealed jar. The evacuating-capping unit is functionally diagrammed in Figure 1. In operation, a jar is positioned in the chamber. A cap is attached to the magnetic plunger disk, and the chamber door is closed. Vacuum is attained and regulated by the pump, the vacuum release valve, and the gauge. The jar is sealed by depressing the plunger carrying the cap holder and cap. Release of vacuum in the chamber completes the operation. The vacuum testing apparatus (Figure 2) consist of a series of

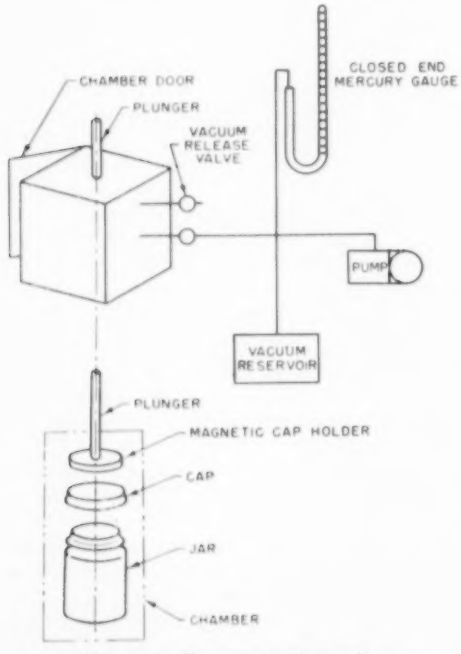

Figure 1. Vacuum capping unit.

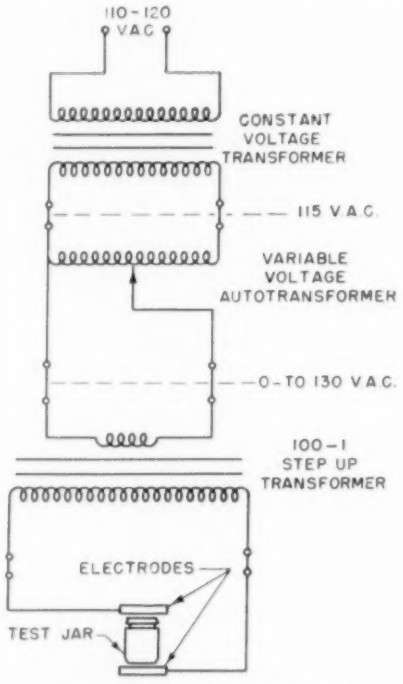

Figure 2. Vacuum testing apparatus.

transformers in cascade terminating in 2 electrode plates. Unregulated 115 V.A.C. is fed into a constant voltage transformer (120 volt-ampere capacity). The regulated output from this is fed into a 0-130 volt variable transformer, the variable output of which is fed into a 10,000 volt step-up transformer. The use of the transformers in the foregoing manner makes it possible to impress upon the electrodes a steady alternating potential which is manually variable between about 1,000 and 12,000 volts. High voltage output, as crest voltage, was measured as a function of the variable transformer reading by feeding the output into a meter quality 100-1 stepdown transformer and then into a vacuum tube voltmeter. The resulting calibration curve permits translation of the variable transformer data into actual crest potentials at the electrodes.

The discharge through the jar is not easily visible in laboratory daylight. This is especially true near the glow extinction point at high vacuum, and for this reason the electrical measurements must be made in a dark room. Attempts were made to insert a meter or other indicator into the circuit in order to permit daylight measurements but the feebleness of the currents flowing through the jar plus the existence of an appreciable amount of leakage or "dark" current were factors working against a simple solution to the environmental problem.

Methods. The sealing of the jars under known vacuums was described in the preceding section. Immediately prior to sealing, about 2 g. of Drierite (anhydrous calcium sulfate) are placed in the jar. The reason for using a desiccant will be given in a following section.

The electrical glow measurement is initiated by placing the jar on one of the electrode plates. The other electrode plate is placed on the jar cover. Potential difference between the plates is steadily increased by means of the variable transformer until electrical breakdown as evidenced by the appearance of a glow discharge in the jar occurs. The potential is then slowly lowered

until the glow disappears. The variable transformer reading at extinction is recorded. Accuracy is increased by determining the extinction voltage two or three times or until a steady value state is arrived at and then recording an average value for the reading.

RESULTS AND DISCUSSION

The relationship between crest voltage or variable transformer reading and vacuum is determined by sealing a series of jars under known vacuums and then measuring glow extinction voltages. A typical calibration curve in which standard 5-ounce baby food jars were used is shown in Figure 3. The tangent to the

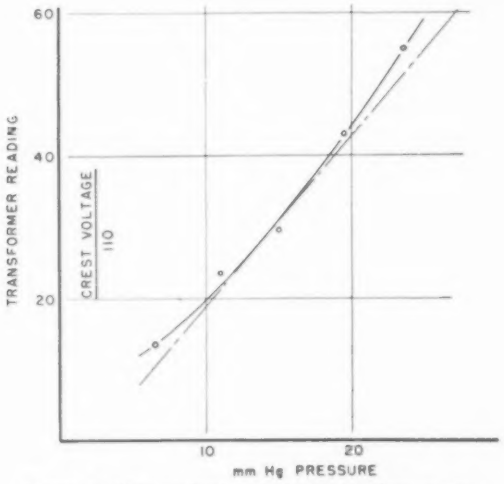

Figure 3. Glow extinction voltage at various vacua.

curve is shown as a dashed line and was used in calculations involving voltage-pressure transformations.

It is quite certain that gas leakage into a glass container takes place in the vicinity of the closure gasket material. This must occur by diffusion, a rate process, which can be simply stated as:

$$\frac{\text{Amount of diffusion}}{\text{Time of diffusion}} = \text{K (a constant)} \times \text{Driving Force} \qquad (1)$$

It is obvious that the "driving force" in this case will be the pressure differential between the jar exterior and interior and that the change in pressure differential due to diffusion during an increment of time, t, will be proportional to the pressure differential itself or:

$$\frac{dP}{dt} = KP \qquad (2)$$

where P = pressure differential, t = time and K is a constant.

Integration of (2) leads to the equation:

$$K = \frac{2.303}{t} \log \frac{P}{P_o} \qquad (3)$$

Where K is the diffusion constant, t is the time, P is the pressure differential at time t, and P_o is the pressure differential at start.

Figure 4 graphically illustrates data obtained with caps of like body construction, made by the same manufacturer, but with differing gasket materials. Each

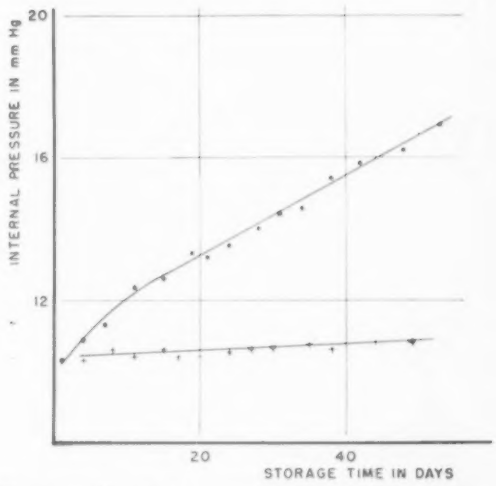

Figure 4. Microleakage in glass jars sealed with caps of different gasket materials.

point in Figure 4 represents a 12-jar average. The sealed jars were retorted for one hour at 212° F. after sealing. The differential, dP/dt, in equation 2 is equivalent to the slope in Figure 4, while P is the mean pressure difference over the considered range. This allows determination of the extent of vacuum loss over any time period. Extrapolation of Figure 4 to longer time periods through the use of equation (3) is given in Figure 5. The jar volume (empty) as used was about 147 cc. If normal filling results in a 14.7 cc. headspace the jars will lose their vacuum ten times as rapidly and K will be ten times as large as that given through solution of equation (2). This factor has been taken into account in Figure 5.

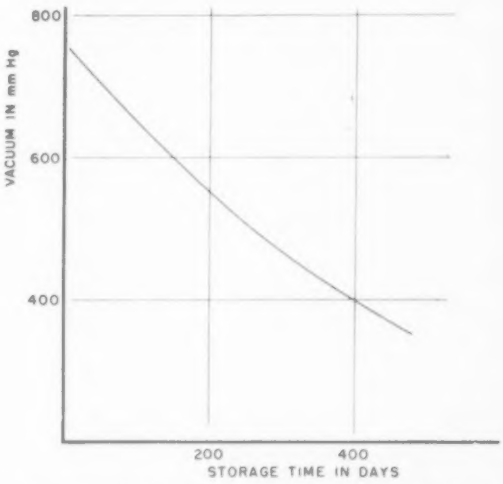

Figure 5. Microleakage in glass jars. (Extrapolated from curve A, figure 4.)

Extension of the method to product- or water-filled jars would be difficult. Water or an aqueous material in the jar prevents the glow from appearing. Saturated caustic solution will reduce water vapor pressure and

permit glow discharge to take place, but in this case accidentally wetted areas above the liquid level will short out the current and produce erroneous results. Eventually it may be possible to develop a concentrated caustic-gel system which would hold the liquid in place and remove the foregoing difficulty.

Another factor which affects the results is occluded and adsorbed moisture in both the caps and glass. Retorting the jars releases significant amounts of moisture and causes abnormal increases and drifts in glow extinction readings. The high voltage seems to "tickle" loose adsorbed moisture from the glass. It was found possible to markedly reduce the severity of this effect by adding small amounts of a desiccant (Drierite) to the jars prior to sealing.

The sensitivity of the method is very high at high vacuums. The calibration curve, Figure 3, shows this to be about 2.5 volts/mm. This amounts to about 1½ scale division on a 130 volt, 330° dial variable transformer which is graduated in 2 volt divisions. The sensitivity of the method is much less at higher internal pressures as demonstrated by experiments carried out with jars 90% filled with mercury. The lack of sensitivity is, in this case, and to a large extent, offset by a much higher rate of pressure drop which results from microleakage into a volume $\frac{1}{10}$ as large.

Attempts to estimate the accuracy of the method itself are complicated by the inaccuracy of the test materials which are the jars and their closures and also by the lack of a standard, sensitive, non-destructive, direct method against which to test it. The basic requirement of such a direct method would be the ability to use it in the measurement of vacuum changes in jars of the order of 10 to 15 mm. So far, as is known, the only means of testing the method would be to puncture-gauge evacuated jars over a long period of time.

Each jar and cap combination of an apparently identical set may be expected to be actually different in its microleakage characteristics as a result of minor non-duplicating differences in each jar and cap itself. Satisfactory results with the glow extinction cap, therefore, only be obtained by using samples of a satisfactory size. Generally, it was found necessary to use a minimum of 6 jars per variable.

Twelve-jar samples were used whenever the experimental variable was of a small magnitude and more precision was required. By increasing the sample size still further, i.e., to 20 or more, it should be possible to analyze statistically variability in microleakage of jar-cap combinations of a particular type.

It should also be noted that a methodological error is present in single jar measurements. The cause of this error is not known, but it may be due to gas adsorption shifts, the presence or absence of trace ionizing materials in the jar, cosmic rays, etc.

The characteristic of the glow discharge phenomenon selected for measurement as described in this paper is that of glow extinction. Actually other properties might also be measured among which are (a) breakdown potential or potential at which the glow first appears, (b) current flow at some fixed potential in excess of breakdown, (c) luminosity at some fixed potential in excess of breakdown. The alternative as in (a) was investigated and measurements so obtained were very erratic. Electrical breakdown in a gaseous dielectric occurs as the result of accidental gaseous ion formations. Sometimes the "accident" occurs at lower potentials and sometimes at higher ones. Alternative (b), measurement of current flow at a given potential, has two disadvantages—(1) the increased complexity of measuring equipment necessary and (2) failure of the gaseous discharges to obey Ohm's law, a fact which would complicate evaluation of the data arrived at in this manner. Alternative (c) was also qualitatively investigated. It was found that a highly sensitive and precisely designed light-gathering system would be required for the method to be operable. Correlation of luminosity data with vacuum would still be necessary and would perhaps be difficult.

SUMMARY

A non-destructive, sensitive method for measuring microleakage into commercial glass containers through the use of electrical glow discharge phenomena has been described.

Acknowledgments

The assistance of the Gerber Research Engineering Staff in designing and building the vacuum closing unit is herewith acknowledged. Thanks are also due to Mr. Sigmund Odegard and the Gardner Electric Company of Oakland for their help in calibrating the electrical glow apparatus.

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Candies

Ice Cream

Beverages

Desserts

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SELECTED ABSTRACTS

(Continued from page 21 preceding technical papers)

procedure based on this observation has been developed which is sensitive to 1 p.p.m. of sulfide sulfur under ideal conditions.

BIOLOGICAL SCIENCES

BIOCHEMISTRY

Whole blood clotting, clot retraction and prothrombin utilization in burros following total body gamma radiation.

TRUM, B. F., AND RUST, J. H. *Proc. Soc. Exptl. Biol. Med., 82,* 347-51 (1953).

There was a retardation of whole blood clotting time. A clotting defect was demonstrated in recalcified oxalated plasmas of burros tested 2 weeks after irradiation. All irradiated burros developed a severe thrombocytopenia and a lessening of clot retraction was noted on the 4th post irradiation day, with no clot retraction after the 16th day when the platelet count was approaching zero. There was a pronounced diminution of prothrombin utilization rate after irradiation. The first change was noted 22 hrs. after irradiation or 3 hrs. after the animals were removed from the exposure field. There was no demonstrable circulating anticoagulant. The possible relation of platelet concn. to the clotting defects is discussed.

Hepatotoxic agents: mechanism of action and dietary interrelationship.

DRILL, V. A. *Pharmacol. Revs., 4,* 1-42 (1952); *Biol. Abstr., 27,* 907, No. 9759 (1953).

The following toxic agents that can cause fatty changes, necrosis, and fibrosis of the liver are reviewed: $CHCl_3$, CCl_4, ethylene and propylene dichlorides, EtOH, benzene, bromobenzene, trinitrotoluene, pyridine, P, As, Se and azo compds. An analysis of the mechanisms by which the hepatotoxic agents and dietary factors damage the liver is given. The increased toxicity to many drugs brought about by diets high in fat or low in protein is as impressive as the protective effect of diets high in protein or in carbohydrate. The exact mechanism for the liver damage is unknown although preliminary data point to an effect on SH groups of enzymes and on oxidation-reduction potentials of the liver cells.

Dietary carcinogenesis.

WILLHEIM, R., AND IVY, A. C. *Gastroenterology, Baltimore, 23,* 1 (1953); *J. Am. Med. Assoc., 151,* 1518 (1953).

Twenty-seven dyes, many of them certified food colors, were fed to rats in concns. of about 4% of the diet by dry wt. Cell changes in stomach, intestinal, and liver tissue are described.

Toxicological and pharmacological studies on chlordane.

AMBROSE, A. M., CHRISTENSEN, H. E., ROBBINS, D. J., AND RATHER, L. J. *Arch. Ind. Hyg. and Occupational Med., 7,* 197-209 (1953).

The following data on the physiol. effects of chlordane are presented: LD_{50} by oral administration in cottonseed oil and EtOH (590 mg./kg. body wt.); effects of cutaneous application in cottonseed oil and EtOH; effects of various concns. in the diet on mortality rate and growth; histopathological findings; hematological studies; storage of chlordane in perirenal fat. It is suggested that chlordane is a cumulative poison, that its rate of elimination or detoxication is slower than its absorption, that it is rapidly absorbed through the integument, and that by this route it is more toxic than by daily oral administration of similar amts.

Sugar alcohols. XXIX. Sorbitan polyoxyethylene fatty acid esters and polyoxyethylene monostearate and respiration of kidney.

KRANTZ, J. C., MUSSER, R. D., AND KNAPP, N. J. *Proc. Soc. Exptl. Biol. Med., 81,* 640-2 (1952).

In kidney slices the addn. of Myrj 52, and Tweens 20, 60, 80 and 81, do not significantly interfere with the oxygen uptake of kidney tissue as detd. by the Warburg technic.

The metabolism of sorbitan monostearate.

WICK, A. N., AND JOSEPH, L. *Food Research, 18,* 79-84 (1953).

Radioactive sorbitan monostearate was fed to rats and the fate of the C^{14} was studied. The distribution of the C^{14} shows that at least 90% of the polyol labeled emulsifier, when fed in oil soln., was hydrolyzed to stearic acid and the anhydrides of sorbitol. When fed as a water emulsion, about 50% of the ester is hydrolyzed. The anhydrides of sorbitol which were liberated by the hydrolysis were largely excreted into the urine before they could be completely oxidized to CO_2. The amt. of C^{14} found in the tissues 48 hrs. after feeding of polyol labeled sorbitan monostearate in oil was 5 to 7% of the administered C^{14}. Fractionation of the crude fat ext. of the tissues (excluding the intestinal tract) indicated that less than 0.1% of the fed C^{14} may represent sorbitans derived from fed sorbitan monostearate or sorbitan esters synthesized from circulating sorbitan.

The fate of caffeine in man and a method for its estimation in biological material.

AXELROD, J., AND REICHENTHAL, J. *J. Pharmacol. Exptl. Therap., 107,* 519-23 (1953).

A sensitive method for the estn. of caffeine in biol. material is described. The method is specific in that it does not include transformation products of caffeine in the measurement. Caffeine is rapidly and essentially completely absorbed from the gastro-intestinal tract of man. Caffeine is almost entirely transformed in man, only about 1% being excreted in the urine. The rate of biotransformation is fairly uniform from subject to subject, the av. half-life being 3.5 hrs. (15% metabolized per hr.). The metabolic rate of transformation in dogs is about the same as in man. Caffeine is distributed in various tissues in approx. proportion to their water content. The drug passes rapidly into the central nervous system. Although a considerable amt. of caffeine accumulates in the body of moderately heavy coffee drinkers during the day, there is no day to day accumulation of the drug.

The metabolism of collagen from liver, bone, skin and tendon in the normal rat.

NEUBERGER, A., AND SLACK, H. G. B. *Biochem. J., 53,* 47-52 (1953).

[Alpha — C^{14}] glycine was injected into rats of varying ages. The animals were killed at different intervals of time and samples of mixed proteins of liver and muscle and of collagen from skin, tendon, bone and liver were obtained. Dinitrophenylglycine was isolated from the hydrolysate of these proteins and its radioactivity detd. In rats more than 14 months old, the activities of the glycine samples obtained from all the collagen fractions were very low, bone collagen showing the highest values. In young adults which were still growing slowly, low activity was observed with skin and tendon collagen, but appreciably higher values were obtained with collagen from bone and liver. With young, rapidly growing rats initial activities were high with all collagen fractions. The difficulties inherent in the interpretation of isotope data in relation to protein metabolism are discussed, and it is concluded that only such changes can be detected as involve participation of free amino-acids in protein turnover. The criteria of purity of collagen are also examd. Subject to the limitations mentioned the results suggest that, even in the adult rat, collagen fibres are continually, but very slowly, replaced, the turnover rates being highest for collagen from bone. It is likely that in young rats this change is somewhat faster. However, in all age groups all collagens showed turnover rates which are low compared with those of intracellular proteins.

Size of dose: its effect on distribution in the body.

STOKINGER, H. E. *Nucleonics, 11,* 24-7, April, 1953.

Tracer studies of biol. distribution of isotopes cannot always be extrapolated to the dosage ranges of interest to toxicologists and therapists. Three distinct mechanisms that regulate the distribution of an element in the body are discussed. Current physicochem. theory is used to explain changes in distribution with dosage.

Duration of drug action.

LOEWE, S. *Proc. Soc. Exptl. Biol. Med., 81,* 596-9 (1952).

The intertwining of temporal and intensity features of drug effects and the necessity of its consideration in their quantitation

(Continued on page 30)

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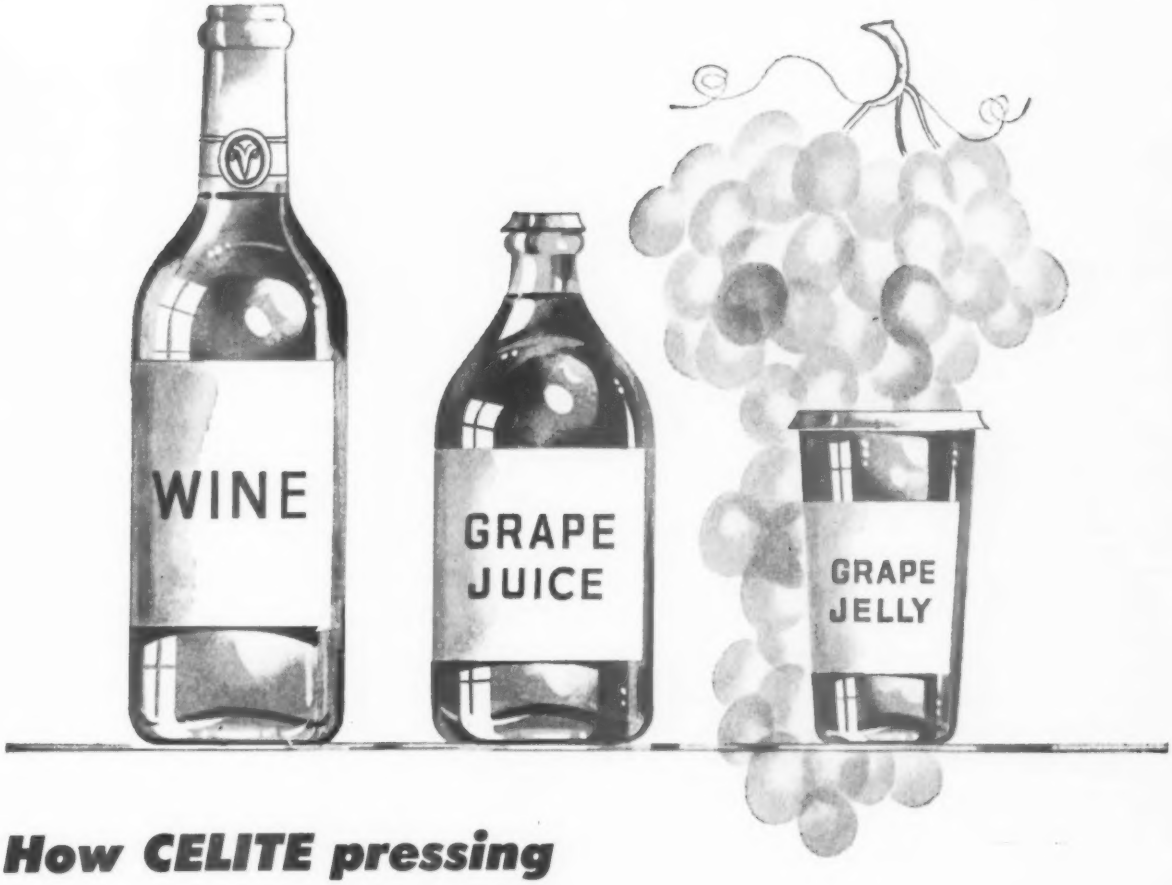

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(Continued from page 26)

are demonstrated by two examples: (a) "duration of effect" requires reference to an endpoint of intensity of effect; it is then appropriately detd. by "median duration" and suitable confidence limits; (b) the customary "median effective dose" is meaningless as a measure of potency unless detd. at the time of peak effect; detn. of "median peak time" and its confidence limits is the prerequisite of ED_{50} detns.

BOTANY

A role for malic acid in tomato fruit-set.

LEOPOLD, A. C., AND GUERNSEY, F. S. *Arch. Biochem. Biophys., 41,* 64-73 (1952).

Malic acid, glutathione, and $MnSO_4$ each and collectively increase tomato fruit-set. Of all the compds. known to promote fruit-set, only malic acid will appreciably increase fruit-set in the presence of glutathione and $MnSO_4$. These findings suggest that the promotion effect of the three compds. in combination may be due to the decarboxylation of malic acid by malic decarboxylase. The addn. of two of the products of the malic decarboxylation reaction (CO_2 and pyruvic acid) each quantitatively inhibits fruit-set in the presence of malic acid, glutathione, and $MnSO_4$. The addn. of ascorbic acid with the three latter compds. further increases fruit-set. These promotive and inhibitory effects suggest that the decarboxylation of malic acid may be beneficial to fruit-set in the tomato. It is suggested that the beneficial effect of this system may be through the activation of a series of linked oxidation-reduction reactions.

Tamed 2,4-D sets seedless tomatoes.

Agr. Research, 1, 7, January-February, 1953.

Spraying greenhouse tomato plants and their blooms with modified 2,4-D caused seedless tomatoes to develop without pollination. 2,4-D was modified by linking it chemically with certain amino acids made in the lab. Two compds. were tested: (1) an "L" form, which made fruit set but deformed the tomatoes and plants; (2) a "D" form, which produced the meaty, seedless fruits without apparent injury to the greenhouse tomato plants. The reason tomatoes reacted differently to these two compds. may lie in the enzymes of the plant. These enzymes may have split the link of 2,4-D and amino acid in the L compound- and thus left the tomato open to the bad effects of 2,4-D. The D link, on the other hand, could not be broken and this compd. was able to set fruits without causing injurious effects.

MICROBIOLOGY

Occurrence of streptococci that give a false-positive coagulase test.

EVANS, J. B., BUETTNER, L. G., AND NIVEN, C. F. *J. Bacteriol., 64,* 433-4 (1952).

Labs. examg. foods for the presence of food-poisoning staphylococci should either use an anticoagulant other than citrate in the plasma employed for the coagulase test or should regard with suspicion any culture that requires more than 3 hrs. to clot citrated plasma.

NUTRITION

Limited protein diet.

Science News Letter, 63, 179 (1953).

A new kind of reducing diet, now being tested for effectiveness and safety, allows patients to eat all the sweet, fat and starchy foods desired, restricting only protein intake.

Metabolic problems of obesity. The nitrogen economy.

BANSI, H. W., BACKAUS, O., AND LOHMEYER, G. *Arch. Exptl. Path. u. Pharmakol., 215,* 181-97 (1952); *Biol. Abstr., 27,* 555, No. 5898 (1953).

N excretion was studied in 60 obese patients and in 23 cases of lipophilic dystrophy. Among 52 obese patients in hunger there were 28 with normal N excretion, 4 with elevated and 20 with lowered rates. Of 50 obese patients on a high protein, low caloric diet, 15 had a neg. balance, 29 had a pos. balance and 6 were in equil. Of 20 patients with lipophilic dystrophy on a high protein, low caloric intake, only 3 showed an N equil. and 17 showed increased N excretion. A neg. balance was seen in 12 of 16 patients on a low protein, high caloric intake. Unfavorable N excretion in many cases was a result of increased catabolism of protein.

The effects of diet and cold on body composition and fat distribution in the white rat.

PAGE, E., AND BABINEAU, L. M. *Can. J. Med. Sci., 31,* 22-39 (1953).

From an insulation standpoint, high fat rations may be beneficial in the cold through an increase in total body fat but not through a more efficient distribution with respect to preservation of body heat since neither the fat content of the ration nor environmental temp. affect fat distribution. Any difference in efficiency of food utilization between high and low fat diets appears to be the same in the cold as at room temp. Livers are smaller on a high fat ration both at room temp. and in the cold. Both livers and kidneys are larger in the cold than at room temp. Av. values for body water expressed as percentages of the lean body mass were the same in the cold as at room temp.

Possible mechanism involved in the growth-promoting responses obtained from antibiotics.

ELAM, J. F., JACOBS, R. L., TIDWELL, W. L., GEE, L. L., AND COUCH, J. R. *J. Nutrition, 49,* 307-17 (1953).

Data presented show that the administration of an antibiotic produced a significant increase in growth and a significant decrease in the total no. of clostridia per g. of feces. Arsanilic acid and sodium arsanilate were shown to increase growth and decrease the total no. of clostridia per g. of feces when fed to chicks.

Effect of terramycin on fecal microflora of rats. I. Interrelation of diet and terramycin.

SCALETTI, J. V., KULP, W. L. AND CLEVERDON, R. C. *Proc. Soc. Exptl. Biol. Med., 81,* 552-6 (1952).

A study was made of changes in fecal microflora of albino rats engendered by changes in compn. of diet, and by incorporation of terramycin in the 3 diets employed. Diets *per se,* showed little or no effect in modifying the counts of total anaerobes and aerobes, *L. acidophilus,* or fecal streptococci, nor was there a statistically significant interaction between terramycin and diet in these groups of organisms. Terramycin caused significant reductions of anaerobes, aerobes, and *L. acidophilus* and a marked increase of fecal streptococci regardless of ration. The counts of *E. coli* were not affected by diet or terramycin *per se,* but a high degree of interaction between diet and terramycin obtained. The action of terramycin on the *E. coli* count was dependent on the type of ration fed, especially as evidenced by significant differences between terramycin-supplemented high carbohydrate-low protein ration and terramycin-supplemented basal ration. Supplementation of all rations with terramycin resulted in a marked increase in nos. of *Proteus spp.* It was especially noted that the effect of terramycin was independent of the ration fed in this case.

Oral use of fat emulsions.

Current Med. Digest, 20, 109, April, 1953.

Emulsions of 40% peanut oil in 10% dextrose or sucrose, both unflavored or with added chocolate flavoring, with a caloric equiv. of 4 cals. per cc., were administered to 200 unselected adult patients in need of extra cals. One hundred and fifty-three of these subjects easily tolerated 125 cc. to 750 cc. daily doses of emulsion averaging approx. 200 cc. per day; 108 gained from 1 to 25 lb. over periods of study ranging from 5 to 150 days. The caloric gains obtained resulted in significant therapeutic contributions to the clinical care of the patients.

Some studies on the destruction of amino acids in proteins caused by autoclaving in presence of glucose.

GIRI, K. V., RAMA RAO, P. B., AND RAJAGOPALAN, R. *Food Research, 18,* 217-22 (1953).

Casein, gelatin, albumin, and fibrin were autoclaved with glucose, and the loss of amino acids of the proteins after hydrolysis was investigated by circular paper chromatographic technic. It was found that autoclaving casein-glucose mixt. for one hr. resulted in complete destruction of arginine whereas in the case of albumin, gelatin, and fibrin the loss of arginine was

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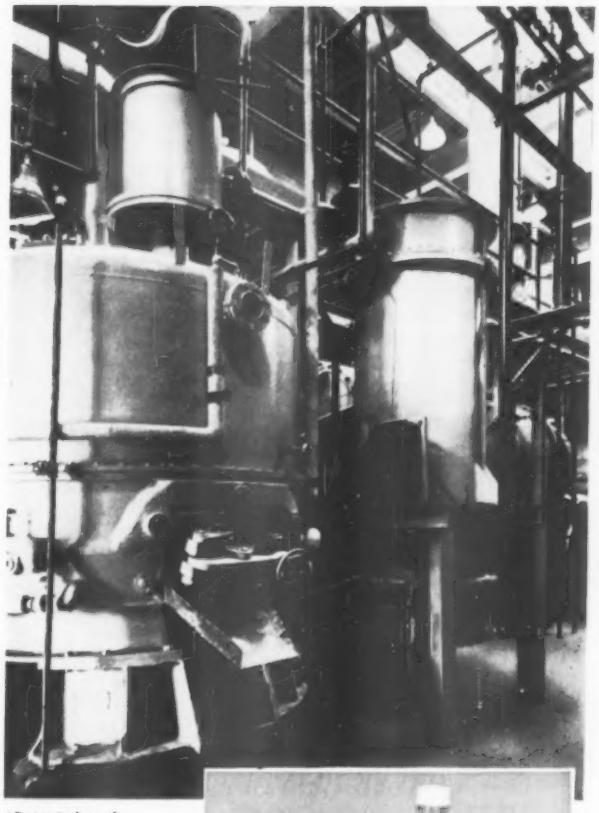

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less than that observed with casein. The destruction of lysine-histidine was of the order of about 50% on a combined basis. Autoclaving for a period over one hr. did not result in a further increase in the percentage loss of any of the amino acids.

The effect of sodium alginate on the destruction of ascorbic acid.

ERICKSON, L. E., AND GASPARETTO, G. *Food Research, 18,* 178-85 (1953).

The influence of sodium alginate on the oxidation of ascorbic acid to dehydroascorbic acid was investigated, varying the concn. of alginate, the temp., the pH, and the concn. of Cu in the test solns. It was found that sodium alginate can inhibit the oxidation in ascorbic acid solns. contg. Cu ions. Sodium alginate was also tested as a possible antibrowning agent, but appeared to be without effect.

Effect of cobalt in diet of the chick.

DAVIS, R. L., BRIGGS, G. M., AND SLOAN, H. J. *Proc. Soc. Exptl. Biol. Med., 82,* 175-7 (1953).

Chick growth was stimulated by the addn. of 10 to 100 mg. of cobalt sulfate to each kg. of a corn-soybean oil meal diet which was deficient in vitamin B_{12}. When similar levels of cobalt sulfate were added to the same diet supplemented with ample vitamin B_{12} they produced no observable effect.

Anticoagulant properties of unheated soybean meal in chick diets.

BALLOUN, S. L., AND JOHNSON, E. L. *Arch. Biochem. Biophys., 42,* 355-9 (1953).

Blood-clotting time of chicks was significantly increased by feeding diets contg. unheated, solvent-extd. soybean meal. Vitamin K was not the limiting factor since clotting time was not reduced by the addn. of this vitamin to the diet. The anticoagulant was heat labile because autoclaving completely abolished the anti-blood-clotting properties of the meal. Age and previous dietary treatment of chicks were not factors affecting the anti-clotting action of unheated soybean meal.

Effect of vitamin C deficiency on healed wounds.

PIRANI, C. L., AND LEVENSON, S. M. *Proc. Soc. Exptl. Biol. Med., 82,* 95-9 (1953).

When young adult guinea pigs bearing linear laparotomy wounds which had healed under normal conditions for 6 weeks were subjected to an ascorbic acid-free dietary regimen for approx. 26 days, severe changes were observed in the scar tissue area. The results indicate that adequate ascorbic acid intake is required not only for normal healing in the early post wound period but also for the maintenance of the scar tissue which has formed in healed wounds over a period of many weeks.

Effect of coconut milk fractions on growth of carrot tissue.

DE ROPP, R. S., VITUCCI, J. C., HUTCHINGS, B. L., AND WILLIAMS, J. H. *Proc. Soc. Exptl. Biol. Med, 81,* 704-5 (1952).

Addn. of coconut milk (7 mg./ml.) to a medium contg. 2% sucrose, 1% agar and White's mineral soln. supported the growth in darkness of Clone II carrot tissue for over a year through more than 100 transfers. Adsorption of coconut milk on Nuchar followed by elution with chloroform-methanol (5:2) gave two fractions, neither of which would support the growth of this tissue alone, but which, on recombination, had the same activity as the original coconut milk. The effect of the eluate factor could be partially reproduced by indole acetic acid. The filtrate factor could not be replaced by any of the chemically defined substances tested.

ENGINEERING AND PLANT EQUIPMENT

Atomization by centrifugal pressure nozzles.

TATE, R. W., AND MARSHALL, W. R. *Chem. Eng. Progr., 49,* 169-74 (1953).

The importance of a tangential velocity component in producing atomization and large cone angles and the effect of viscosity on drop size are shown. Charts and photographs illustrate the effects of other variables.

FOOD AND FOOD TECHNOLOGY

BAKING AND BAKERY PRODUCTS

An improved relaxometer for viscoelastic substances applied to the study of wheat dough.

CUNNINGHAM, J. R., HLYNKA, I., AND ANDERSON, J. A. *Can. J. Technol., 31,* 98-108 (1953).

Relaxation curves have adequate reproducibility. The distribution function of relaxation times is obtained by differentiation of the relaxation curve. Increasing the water content of the doughs decreases the magnitude of the distribution function but does not markedly alter its shape, while increasing the rest period causes a greater concn. of relaxation times at the short time end. Decreasing dough protein content also appears to change the shape of the distribution function in a manner somewhat analogous to that of increasing water content.

Flavor deterioration in frozen cake batters.

MEYER, B., MOORE, R., AND BUCKLEY, R. *Food Research, 18,* 70-5 (1953).

The flavor deterioration in frozen sponge cake batters may be caused by oxidation of the egg-yolk lipids during freezer storage. Egg-white sponge cakes did not deteriorate in flavor through 6 months of freezer storage, whether they were baked before freezing or frozen in the batter state. Whole-egg sponge cakes, with a lipid content of 4.9% of which 97% was from egg yolks, developed off-flavor after 4 weeks and were inedible after 6 months of freezer storage in the batter state. No off-flavor developed when these cakes were baked before freezing. Egg-yolk sponge cakes with a total lipid content of 8.3%, of which 97% was from egg yolks, developed pronounced off-flavor after 2 weeks and were inedible after 2 months of freezer storage in the batter state. Cakes baked before freezing began to develop off-flavor after 2 months of freezer storage. There was marked peroxide development in whole-egg and egg-yolk sponge cakes frozen in the batter state. Both flavor deterioration and peroxide formation were proportionate to the concn. of egg yolk in the batters. The addn. of a fat antioxidant or lemon juice to whole-egg sponge cake batters delayed the development of off-flavor and the formation of peroxide during freezer storage. Shortened cakes frozen in the batter state developed slight off-flavor after 9 months of freezer storage when hydrogenated vegetable oil was used, but not when butter was used. No off-flavor developed when shortened cakes were baked before freezing. There was no evidence of peroxide formation in any of the shortened cakes.

How bakery products react to low temperature freezing.

GLABAU, C. A. *Bakers Weekly, 158,* 47-8, April 6, 1953.

There is no marked difference between the rate of staling of sweet yeast dough products which have not been frozen and those which have. While under crit. lab. conditions, a slight difference in the softness over the first three or possibly four days is found, it is not great and could not be detected by the consumer. The rate of staling of frozen baked goods in relation to the same type of products which have not been frozen varies with the degree of richness. Yeast leavened goods of a so-called leaner nature will show a greater difference than is the case with the richer products.

CEREALS AND GRAINS

The solubility of wheat gluten.

DEDEKEN, R. H., MORTIER, A., AND WIAME, J. M. *Biochim. et Biophys. Acta, 10,* 488 (1953).

By lyophilisation of the gluten, it is possible to store it without denaturation, oxidation, or proteolysis and this procedure allows reproducible and quant. results. About 50% of the gluten is solubilized under slow mech. motion in water plus an equal vol. of pyridine, dioxan, acetone or ethanol. An almost complete solubilization may be reached in the same mixts. with vigorous stirring in a Waring blendor. From this soln., the gluten can be repptd. without apparent alteration of its original mech. and soly. properties. The solubilization of gluten in water with the Waring blendor is variable (from 3 to 50%). At pH 11, an aq. soln. can be obtained. The proteins of this soln., kept at ordinary temp., undergo modification of their soly. and mech. properties, but this transformation is negligible at 0° C. The

variability of the soly. of gluten in water is probably the result of the oxidation of the protein. This interpretation arises from the fact that gluten is rapidly and completely dissolved in reducing solns. (M/100) at pH 11, at 0° C. under slow mech. motion. The soly. in water at pH 11 under the same conditions varies with the sample (e.g. 30% of the total gluten). The reducing substances used are: sodium sulfide, cyanide, cystein, thioglycolate and ascorbic acid. The pptn. at pH 6 of the reduced proteins shows that the mech. properties (elasticity) of the original proteins are lost. The soly. of gluten is typical of mols. with a low content in ionisable groups: the glutamic and aspartic residues are amidated. The reaction toward reducing agents shows the essential role of the -S-S- groups in the mech. properties and it is likely that this is a major factor in the diversity of wheat and explains the beneficial action of oxidants in the treatment of flour.

COFFEE

Comparative effects of coffee and soluble extracts of coffee on normal persons and on cardiac patients.

Polonovski, M., Donzelot, E., Briskas, S., and Doliopoulos, T. *Cardiologia (Basel), 21,* 809 (1952); *J. Am. Med. Assoc., 151,* 1238-9 (1953).

Since sol. exts. of coffee have been prepd. industrially, it has been asserted by some that these exts. are tolerated less well than coffee prepd. from ground beans. It is also generally admitted that both ordinary coffee and the sol. exts. cause signs such as cardiac palpitation and nervous manifestations in normal persons and in cardiac patients. The authors tested 302 patients who had just been admitted to hospital, including 69 with cardiac complaints and 233 free from heart disease. All of these patients received for 10 consecutive days a cup of coffee at their midday meal, but some drank exts. of coffee roasted in beans and others solns. of industrially prepd. sol. ext. Generally speaking, normal subjects and cardiac patients tolerated sol. coffee exts. as well as the infusion of bean coffee. Ordinary coffee, as well as decaffeinized coffee or sol. coffee ext., produced a slight acceleration of the pulse and a slight raising of the blood pressure in both normal persons and cardiac patients. Manifestations of sensitivity to highly roasted coffee, whether in the form of sol. ext., bean coffee or decaffeinized coffee, took the form of trembling, palpitations, insomnia, nervousness, nausea, fatigue, and extrasystoles. Caffeine, administered in the proportions contained in the coffee, ingested in the form of sol. ext. or ordinary coffee did not produce disturbances in either normal patients or those with heart disease. It appears therefore that the extn. of other components of the coffee, apart from caffeine, and above all the degree of roasting, play a major part in the production of the various disturbances, particularly in the appearance of extrasystoles.

FATS AND OILS

Antioxidant material from the Osage orange.

Clopton, J. R. *J. Am. Oil Chemists' Soc., 30,* 156-9 (1953).

0.1% of the Osage orange antioxidant approx. doubles the AOM (active oxygen method) stability values for cottonseed and soybean salad oils. It increases the stability of hydrogenated soybean oil 2.5 times and that of hydrogenated lard about 4 times. It failed to affect the stability of the samples of hydrogenated cottonseed oil tested. The Osage orange antioxidant may prove useful in such materials as oil-sol. vitamin concentrates, cosmetics, pharmaceuticals, lubricating greases, and many other substances that are subject to oxidative deterioration. In concns. required for antioxidant function, the Osage orange antioxidant imparts no noticeable flavor or odor and is nontoxic. Large doses of the antioxidant have been fed to rats over a period of several weeks without any apparent ill effects on growth or metabolism of body tissues.

The flavor problem of soybean oil. XI. Phytic acid as an inactivating agent for trace metals.

Evans, C. D., Cooney, P. M., Moser, H. A., and Schwab, A. W. *J. Am. Oil Chemists' Soc., 30,* 143-6 (1953).

Phytic acid added to regularly processed edible oils at the 0.01% level showed a marked improvement in the organoleptic and oxidative stability of these oils. It was not established whether the mode of action of phytic acid was the result of the direct formation of insol. phytate salts, or the breakdown of phytic acid with the formation of phosphoric acid which would serve as the active agent. Phytic acid solns. all contained some free phosphoric acid. Most phytic acid samples darkened with age and showed a progressive increase in the amt. of free phosphoric acid. To be effective, it was necessary to add phytic acid prior to the deodorization process. Evidence is presented to show that a large part of the synergistic effects of many activators can be explained by metallic inactivation. It is suggested that much of the antioxidant effect observed for rice bran, oat "flour," and cereal brans could be the result of metal inactivation by the phytic acid present in these materials.

The Chayen process for extraction of oils and fats.

Coulson, J. M. *Nature, 170,* 881 (1952).

Crushed bones are passed, together with a stream of water, into a modified disintegrator where complete fat rendering is achieved in about one second while the material is in the mill. The fat and degreased bone leaving the mill are sepd. by gravity from the water stream, the fat being skimmed off and purified and the bones passed on for drying, when they are ready for glue making or for incorporation in bone meal. The importance of this technic lies in the fact that it has provided a new chem. engineering tool and principle, the use of high-speed impulses, to break down mech. barriers, in this case the cell-walls. The degreased bone is ready for glue making in 8 min. and the fats are of much finer quality, since the process is carried out in the cold. The continuous process offers many advantages compared with the old batch one in the form of simplified plant layout and operation, as well as very considerable saving in fuel.

FEEDING STUFFS

The significance of alfalfa meal as a source of unidentified factors required for chick growth.

Scott, H. M. *Feedstuffs, 25,* 54, March 28, 1953.

Of the 10 samples of meal tested, none has failed to stimulate chick growth. Generally, the suncured meals have resulted in a greater response than have the dehydrated meals. The magnitude of the response from alfalfa meal is equal to that noted for forage juice concentrate. A combination of alfalfa meal and forage juice concentrate gives no greater response than when these supplements are fed alone, suggesting that the same factor is probably involved.

What have we learned about antibiotics and arsenicals in feeds?

Bird, H. R. *Feedstuffs, 24,* 18, 20-2, October 11, 1952.

Antibiotics are useful in feeds for growing non-ruminants. Among poultry feeds, broiler mashes and turkey starting and growing mashes are most improved by their addn. There is no danger of toxicity in their use. They have been fed at levels 20 to 30 times as great as are being used commercially, with no harmful effects. Information is meager, but results reported so far indicate that there is no significant accumulation in the flesh. There is evidence that detectable quantities are transferred from the hen's diet to the eggs. The effect of antibiotics on growth may well be a multiple effect, but it seems likely that under practical conditions, the principal effect involves the intestinal microorganisms. Two phenylarsonic acids are being used commercially in feeds. They are 3-nitro, 4-hydroxyphenylarsonic acid and arsenilic acid, which is used both as the free acid and as the Na salt. The most effective level of the 3-nitro compd. is .005% of the diet. The most effective level of Na arsenilate is about .009%. A level of .02% of the 3-nitro compd. is toxic to growing chickens. Arsenilic acid is less toxic, but it is toxic enough to necessitate careful handling. When the levels fed are low enough to be safe for the chickens, the increase in the As content of the tissues is negligible. Much of the As that is found in the tissues is excreted within three days after the drug is removed from the diet.

SELECTED ABSTRACTS

FRUIT AND VEGETABLE JUICES

Puffed powder from juice.

STRASHUN, S. I., AND TALBURT, W. F. *Food Eng., 25,* 59-60, March, 1953.

High temp. vacuum dehydration of fruit and vegetable juices produces a powder which is instantly sol. in ice water. Flavor stabilization and packaging are described. A flow diagram of the process is given.

GELATIN

New advances in jelly-strength testing.

FYSH, D., AND WARD, A. G. *Food, 22,* 111-13 (1953).

A new device for calibrating the Bloom gelometer enabling agreement between different testing labs. on jelly strengths is discussed.

The solubilization of collagen.

JACKSON, D. S. *Biochem. J., 52,* xxix, December, 1952.

In an attempt to increase the percentage of collagen dissolved, the effect of bull-testis hyaluronidase was studied. This enzyme is active against chondroitin sulfuric acid, a known constituent of tendon. The results suggest that chondroitin sulfuric acid is responsible for the relative resistance of collagen to solubilization in dil. acetic acid, and may account for the anomalous swelling behavior at alk. pH.

LEGISLATION

Permitted food additives in Sweden.

HINTON, C. L. *Food, 18,* 117-18 (1953).

The list includes preservatives; antioxidants and neutralizers; natural and synthetic coloring matters; flavoring substances; addns. to butter, cheese, cooling drinks and confectionery; emulsifying agents, anticoagulants, stabilizers and lubricants; flour improvers; numerous inorg. and org. salts of Na, K and Ca; enzymes and enzyme prepns.

ODORS

Atmospheric odors: their effect on flavors of stored foods.

TURK, A., MESSER, P. J., AND BLASKIEWICZ, A. *J. Agr. Food Chem., 1,* 79-82 (1953).

Stored food is subject to many types of flavor adulteration by absorption of odorous vapors during cold storage. Such adulteration can be studied by considering the relation between the concn. or odorous intensity of vapors in the storage space and the organoleptically demonstrable changes in flavor of the stored food. Ventilation or methods of air purification can be effective in preventing such flavor adulteration by reducing the av. storage vapor concns. Food being tested was stored with a variety of odor-contamination sources, in rooms with and without air purification by activated carbon. Flavor differences, evaluated by taste panel comparisons, were statistically very significant. No significant differences were detected between food stored with carbon and an odor source and equiv. food stored alone. The av. vapor concns. were estd. by analysis of carbon sorbates. The results show that significant flavor adulterations of stored food may be caused by storage odors, and that such adulteration is preventable by suitable air purification.

PECTIN

Effect of degree of esterification on viscosity and gelation behavior of pectin.

PIPPEN, E. L., SCHULTZ, T. H., AND OWENS, H. S. *J. Colloid Sci., 8,* 97-104 (1953).

Pectin was esterified with diazomethane so that degradation did not occur. The intrinsic viscosity was found to decrease with increasing degree of esterification. Max. shear modulus of high-solids content gels contg. 0.3% pectin of nearly const. chain length was obtained near a degree of esterification of 40%. The significance of these findings to the theory of pectin gel formation is discussed.

INDUSTRIAL CHEMISTRY

High chemical productivity in U. S.

Mfg. Chemist, 24, 58-61 (1953).

Productivity in the U. S. chem. industry is at least three times greater than in Britain. Two fundamental reasons for this are: (a) a greater percentage of modern chem. plants and equipment than in Britain; (b) a far larger no. of technically qualified employees. The ratio of productivity of the U. S. industry to the British is also the ratio of the proportion of tech. men to employees in the two industries.

PACKAGING

Brewery installation shows package check-up possibilities for flour and pre-mixes.

Am. Miller, 82, 48, March, 1953.

The unit employs an extremely thin beam of x-rays from a low-voltage tube, directed across the production line toward a cadmium sulfide crystal mounted as part of an elec. circuit. The crystal detector is placed at the desired height of fill level. Known as a high-speed level checker, the unit is capable of inspecting cans or cartons at rates far greater than those at which any processing line presently operates, and can work at a speed of 900 containers per min. within an accuracy of 30 drops of beer. In addn. to beer, the unit can be adapted to inspecting many products packed in cans or cartons, including cereal breakfast foods, flour and pre-mixes.

PHYSICAL RESEARCH

Mechanism of gel formation of serum albumin. Investigation by means of streaming double refraction.

BARBU, E., AND JOLY, M. *Bull. Soc. Chim. Biol., 32,* 116-22 (1950); *Biol. Abstr., 27,* 809, No. 8681 (1953).

At pH below 11.5 the process of gel formation of serum albumin is very similar to that of gelatin. First, filaments are formed by agglomeration in chains of the protein mols. Then these filaments grow and become lumped together in a complicated and irregular network. The structure of the gels obtained in strongly alk. soln. without heating is entirely different. They do not consist of long filaments, but have a structure more or less similar to that of glass.

RADIOCHEMICAL TECHNOLOGY

Facilities for gamma irradiation.

MANOWITZ, B. Nucleonics, *11,* 18-20, March, 1953.

A summary of the facilities for irradiation work available at Brookhaven National Laboratories giving some of the details of the special equipment.

Setting up a radiochemical laboratory: I.

Mfg. Chemist, 24, 147-51 (1953).

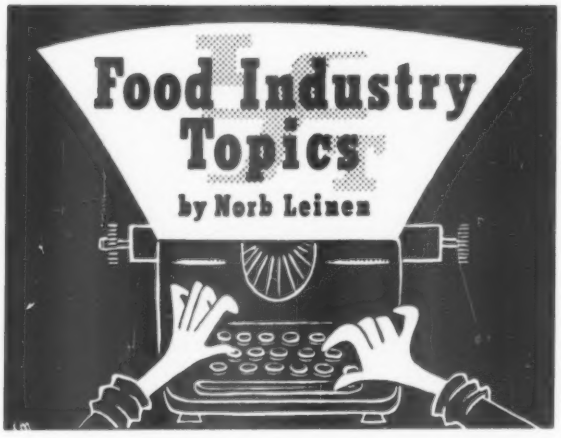
The basic information needed for the setting up and equipping of radiochem. labs. for the handling of radioactive materials emitting beta and gamma radiation is presented. Health precautions, handling routines and technics, clothing and contamination problems are among the aspects of radiochem. technology discussed.

PATENTS

Method for the preparation of undevitalized wheat gluten.

SLOTTER, R. L., AND DELAP, J. A. Assignors to U. S. A. 2,631,379, March 17, 1953.

A process for prepg. dry, undevitalized wheat gluten comprising prepg. undevitalized wet wheat gluten into a form having at least one dimension of less than 0.030 in. and contacting the form with air heated to a temp. of about from 150° to 200° F. until its moisture content has been reduced to about from 4 to 7%, the state of undevitalization being as measured by an acetic acid soly. of 70 to 75%.



. . . in the public interest

A new "electric eye" method of determining the egg content of noodles has been developed by three chemists at the Army's Quartermaster Subsistence Testing Laboratory, Chicago, according to word from the American Chemical Society. The test may aid the Quartermaster Corps in establishing whether suppliers of noodles for the Army have met the rigid specifications for egg content which state that egg noodles must contain at least "5.5% egg yolk solids." As an index of egg content, the chemists—John E. DesPaul, Albert Weinstock, and Charles H. Coleman—measured the amount of a fatty, phosphorus-containing product in the noodles. This product, called lipoid phosphoric acid, is found in definite amounts in egg yolks. A high amount of lipid phosphoric acid in the noodles indicates a high egg content, the ACS explains. In the new test, an extract of ground noodles containing lipoid phosphoric acid is treated with a blue dye. The intensity of the resulting colored solution is measured by a device known as a photoelectric colorimeter. A deep shade of blue, formed by high concentrations of lipoid phosphoric acid, indicates the original noodles contained relatively large amounts of egg. The exact amounts are calculated on the basis of readings obtained from the colorimetric device.

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The Refrigeration Research Foundation, 200 Midland Bldg., Colorado Springs, Colorado, encloses a brief report on three Training Conferences for refrigerated-warehouse operative personnel recently conducted by the Foundation and the National Assn. of Refrigerated Warehouses. The four-day Conferences, held at St. Louis, San Jose, Calif., and Baltimore, comprised intensive reviews of the fields of mechanized handling, conversion and construction of facilities, operation with maximum efficiency, dock inspection of commodities and carriers, calculation of costs, labor relations, public relations, safety, new developments in commodity fields, new products, and new services.

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An attractively illustrated 16-page brochure, *Biological Research at Stanford Research Institute*, outlines that organization's procedures and facilities in the following research fields: biochemistry and nutrition,

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FOOD INDUSTRY TOPICS

toxicology, histology and pathology, pesticide investigation, and microbiology. For a copy of the brochure write, Stanford University, Division of Economics Research, 1915 University Ave., Palo Alto, Calif.

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The Hormel Foundation of Austin, Minnesota, announces the manufacture of small quantities of highly purified fatty acids and methyl esters for distribution to research workers in the field of fat chemistry. This public service was inaugurated because these materials generally could not be purchased from other sources, and the project is conducted as a non-profit venture. Although the cost of manufacture is necessarily high, prices are reportedly much below the cost that would be involved if an investigator were to prepare the material himself. Materials available are palmitic, stearic, oleic, linoleic, and linolenic acids and their methyl esters plus a new material—arachidonic acid—which should prove valuable in elucidating the role of essential fatty acids in nutrition. All of the materials are shipped in sealed vessels with complete protection from oxidation. Analytical values indicating purity are also provided. Further details and prices may be obtained by writing to the Hormel Foundation, Austin, Minn.

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Lead article in the June issue of *Industrial Bulletin*, published by Arthur D. Little, Inc., Cambridge, Mass., provides a highly "scentsible" account of a new approach to the age-old problem of determining exactly how different odors are perceived and remembered. The new theory, suggested at a recent conference sponsored by the New York Academy of Sciences and the American Society of Heating and Ventilating Engineers, seeks to explain odor memory and other facts in terms of the number and properties of the nerves available to carry the information. Nostrils of animals which respond to odors contain great numbers of olfactory receptors—connected to the brain by means of nerve pathways or neurons, each made up of 24 nerve fibers. The new theory proposes that the bundles of 24 neurons all meet in the brain at a sort of central "switchboard" which can be compared to a panel of 24 electric lights. If some of these are "lighted," a recognizable picture is formed. Similarly, any given odor will stimulate the 24 "lights" in such a way as to form a code for that specific odor and for nothing else. With 24 lights, there are almost 17 million combinations possible, more than enough to provide individual codes for each of the recognizable odors. The codes are completely individual, and yet the pattern is composed of so few elements that it is easily "remembered."

. . . things new under the sun

A new and effective replacement for Coumarin has been brought out by Florasynth Laboratories, Inc., New York 61, N. Y. Called Protovanol "C," the product is reported to be the approximate equal of Coumarin in strength and is fully soluble in alcohol, propylene, and to an extent even in vegetable oils. The manufacturer states that the product has amazing versatility, is readily mixed in various dry bases, and is readily absorbed in cane sugar, corn sugar, or starch. For test purposes, Protovanol "C" is available at the volume price of $5 per pound. Florasynth maintains branches in most principal cities of the U. S. and in Canada and Mexico.

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A strikingly new and efficient pressure feeder has been announced by John T. Collins & Co., 21 Maple St., Summit, N. J. The Collins-Adey Differential Pressure Feeder, now available to the processing industry, makes it possible to feed bulk materials into and out of a pressure or vacuum chamber without stopping the processing operation. The device is mechanically operated and moves material by gravity or mechanical means through an intermediate pressure lock from one pressure to another. Balance ports equalize pressure between the several adjacent sections, thereby making it possible to feed unprocessed material into the production flow, while moving the processed material along the line. The opening of the gates and chokes is automatic and, when mechanically closed, gates are locked and sealed against loss of pressure or vacuum. Each unit is individually designed to meet each processing need and give optimum operation for free flowing or slow moving materials.

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The Aire-Regulator Model 206CDR, a testing cabinet for high and low relative humidities at 40° F. to 140° F., is announced by Food Technology Inc., 5903 Northwest Highway, Chicago 31, Ill. The cabinet is the same as the company's standard model 206CD except that it is equipped with a self-contained refrigeration unit having three sets of controls by means of which it is possible to maintain constant temperatures below ambient. Outside dimensions are: 70½" high, 24½" deep, 34" wide. This size testing cabinet and other larger capacity models made by the firm are in use throughout the country by leading food, pharmaceutical, and many other types of manufacturers.

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Using the coffee-roasting plant of Eppens, Smith Co., Inc., Long Island City, as a plant-size demonstration model, inventor Eugene J. Houdry, famed pioneer in the catalytic cracking of petroleum, recently showed top city officials and executives of the coffee industry in New York how his amazing new catalyst —the Oxycat—can end coffee plant odors and many other pollution problems. Houdry, president of Oxy-Catalyst, Inc., Wayne, Pa., manufacturer of the Oxycat, pointed out that his catalysts —each a cage-like structure of coated porcelain rods—are the most economical means available for combustion of hydro-

CATALYST MAKES THE DIFFERENCE—seeing (and smelling) is believing to George Hedden, plant manager of Eppens, Smith Co., Inc., Long Island City as he observes the difference that a catalyst can make.

carbon pollutants. The catalytic coating—alumina and platinum alloy—on the surfaces of the Oxycat rods permits combustion of coffee fumes at a temperature of 500-550 degrees—much lower than the temperature needed for direct flame incineration.

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Florida's orange juice canners saved the nation's housewives more than 8,000,000 days in the kitchen during the past year, reports C. J. Heintz, Tampa district sales manager for American Can Company. The state's canners squeezed this amount of leisure time into the lives of American homemakers by canning more than 100,000,000 gallons of frozen concentrate and single-strength orange juice during the 1951-52 season. ("Canasta, anyone?")

American Can also is in this month's news with a new pear-shaped sanitary style ham can in the 3- to 4¼-pounds category. The new container is of the double-seamed, sanitary type that permits faster closure rates by packers and is key-opened, while competitive foreign ham containers are of the soldered-seam type. According to Mr. R. D. Folk, commodity manager for Canco's Central Division, all indications point to wide consumer acceptance of this smaller canned ham. The new can, designated No. 1 size, augments others currently on the market. These are the No. 2, 4½ to 7 pounds; No. 4, 7 to 10 or 12 pounds, and No. 5, 12 to 14 pounds. In addition, Canco has made available to packers two new models of modern closing equipment for the various sizes of the sanitary style whole ham containers.

. . . *the literary corner*

Fritzsche Brothers, Inc., Port Authority Bldg., New York 11, N. Y., sends in a set of Flavor Data Sheets and an accompanying Flavor File Folder, which items were first introduced to the trade by the firm at the recent IFT Boston meeting. The individual data sheets are intended to provide concise, easy-to-use data relating to the various Fritzsche products, arranged in attractive format and with excess verbiage eliminated. The file folder, of convenient letter size, is provided with the data sheets and will also accommodate additional sheets to be released in the future. Any readers who desire a set of these data sheets with file folder may obtain their request by writing the company at 76 Ninth Ave., New York City, Department T. (They really are schoen.)

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M. Henri Cheftel, French IFT member, has sent your columnist this illuminating note: "It may interest your readers to know that Société OFCO, a division of Société des Fermiers Réunis, the largest distributor of fresh milk in France, manufactured canned sterile whole milk on a commercial scale since 1938. The process was developed by Dr. Jean Pien, head of their research laboratories, and suggested by the methods used for the canning of tomato juice. Société OFCO, producer and distributor of certified milk from TB free herds and stables, has, to begin with, a high quality milk. The milk is homogenized, de-aerated, preheated to 70° C., filled into 1/1 (No. 2½) cans, which after seaming are processed in a batch type rotating retort where they rotate on their axes at 60 r.p.m. Temperature: 125° C.; Time: 3½ minutes. Rapid cooling in water. The milk remains almost white. I have personally kept some cans from 1939 to 1944, when their content, despite some browning and fat separation, was still edible." Vive la France! Vive M. Henri Cheftel. Vive la Laboratoire de Recherches!

How Standard Oil of Indiana keeps more than 36,000 instruments, valves, and control devices in operating condition; the use of centralized instrumentation in the Aluminum Company of Canada, Ltd.'s new contact sulfuric acid plant in Quebec; how instruments are used in guided missile research—these are a few of the features appearing in the 40-page Second Quarter issue of Minneapolis-Honeywell's *Instrumentation*. Also included are basic informative articles on strain gages; thermocouples and extension wire, and diaphragm motor control valves. For a free copy of this interesting publication write Minenapolis-Honeywell Regulator Company, Industrial Division, Station 64, Wayne and Windrim Aves., Philadelphia 44, Pa.

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Latest word on woven glass fabrics impregnated and coated with "Teflon" tetrafluoroethylene resin is available in a new technical bulletin compiled by the Du Pont Fabrics Division. Not only are the outstanding electrical and mechanical properties of these fabrics, tapes, and laminates set forth in tabular form, but uses in other fields are also touched upon. The chemical and solvent resistance, high and low temperature characteristics, and anti-adhesive and anti-friction properties of various glass fabrics coated with "Teflon" suggest applications in the aircraft, chemical, food processing, packaging, paper, plastics, printing, rubber, textile, and other industries. Copies are available on request to Du Pont Co., Fabrics Division, Room 812, 350 Fifth Ave., New York, N. Y.

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Three bulletins in the mail from Cherry-Burrell Corp., 427 W. Randolph St., Chicago 6. Bulletin G-478 describes the new Case Washer which can be used to clean almost any type of box, case, or crate—with the open side either up or down. This double compartment washer, only eight feet long by two feet wide, cleans ten cases every minute and will fit into any power conveyor line. Bulletin G-480 describes and illustrates the "Icy Kold" Farm Tank—a self-contained "package" unit that features instantaneous cooling without agitation, ice bank reserve refrigeration, and easy installation. Bulletin G-479 is devoted to the company's experience in custom-building, stainless steel storage tanks of many types and sizes. Among the 20 photographs are single shell, insulated, refrigerated, and heated tanks—both rectangular and cylindrical. Many accessories such as air agitators, mechanical agitators, peepholes, and automatic level indicators are depicted. Also included in the bulletin are tables of typical tank dimensions.

. . . *conference room and meeting hall*

Progress in the chemical control of viruses, the latest advances in nuclear power for industry, and new developments in the technology of food packaging will be reported at the American Chemical Society's 124th national meeting in Chicago, September 6 to 11, it was announced by Prof. Farrington Daniels, Society president. More than 8,000 chemists and chemical engineers from the U. S. and foreign countries will participate, and over 1,000 technical papers are scheduled for the five-day program to be conducted by the Society's 21 scientific divisions. Sir Robert Robinson of Oxford University, Nobel Prize-winning chemist and internationally known authority on vitamins, hormones, and other natural chemicals, will receive the Society's Priestly Medal—highest honor in American chemistry—at a general assembly Monday night, Sept. 7. The Society, the world's largest professional association of scientists, has 67,000 member chemists and chemical engineers, representing 142 local sections throughout the United States, and in Puerto Rico and Hawaii.

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FOOD INDUSTRY TOPICS

On the lighter side at the recent IFT Convention in Boston, was the "Pepper Berry Guessing Contest," conducted by The Griffith Laboratories, Inc., Chicago. Now it can be told. The correct number of berries in the jar was 15,537. Here are the winners: 1st prize, Toastmaster—Mr. C. W. Kaufman, Kraft Foods Co., Chicago; 2nd prize, Steam Iron—Mrs. M. H. Taras, C. A. Swanson & Sons, Omaha; 3rd prize, Knife Sharpener—Mr. Hubert Harriman of MIT. Winners of the No. 18 Griffith Spice Set were: Mrs. Ed. E. Anderson, Amherst, Mass.; Mr. David G. Bernard, Dewey & Almy Chemical Co., Cambridge, Mass.; Mr. R. F. Ellis, Oak Park, Ill.; Mr. Al. J. Fineberg, Brooklyn, N. Y.; Mr. Harry A. Fischer, Long Island City, N. Y.; and Mr. Leroy V. Strasburger, Baltimore, Md. Ah-ah-ah-CHOO!

◆ ◆ ◆

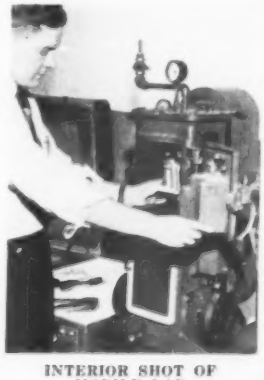
The Chemical Specialties Manufacturers Assn., Inc., will hold its 40th Annual Meeting in Washington, D.C., on December 6, 7, and 8, 1953, at the Mayflower Hotel. A large attendance is expected and there will be many special features commemorating the many years of the Association's activity and the many accomplishments for the benefit of all the industries represented. The original association from which the CSMA developed was organized in 1914. There are now 300 members.

◆ ◆ ◆

Copies of the following papers presented at the Seventeenth Annual KLEN-ZADE Educational Seminar, held March 26, 27, and 28 at East Lansing, Mich., are now available: (1) "The Klenzade Seminar—Objectives and Opportunities;" (2) "Advancements in Sanitation Bacteriology;" (3) "Progress in Sanitation Chemistry;" (4) "Engineering for Improved Sanitation;" (5) "Accomplishments of a Planned Sanitation Program;" (6) "A Sanitation Program for the Future;" and (7) "Sanitation Can Be Sold." Write Klenzade Products, Inc., Beloit, Wis.

. . . *building up and branching out*

In its continuous development of scientific services for the food packing industry, Continental Can Company, New York City, announces a new mobile test unit which literally takes the company's research directly to the processor. The unit was created to give frozen food packers in-plant research assistance in producing the highest quality products through the most economical methods. Consisting of a recording potentiometer, an atmospheric closing machine, a gas-and vacuum-closing machine, and a freezing unit, and requiring two operators, the "suitcase laboratory" can be set up in an area only six feet by eight feet, yet it carries out in miniature all the basic operations of a full-sized plant. By analyzing information obtained from this equipment, Continental men come up with answers to questions like: "What is the optimum temperature and time for freezing a particular product?" "What size and shape container is most effective for freezing the product at its optimum time and temperature?" "Does pre-cooking or blanching improve the quality of the



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7.

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This list was given in more detail almost 10 years ago in an Oil & Soap article* by Higgins and Black. Antioxidants have been greatly improved since then, but the above properties still offer an excellent yardstick against which to compare your present antioxidant.

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*Higgins and Black, Oil & Soap, Vol. XXI, No. 9, 1944.

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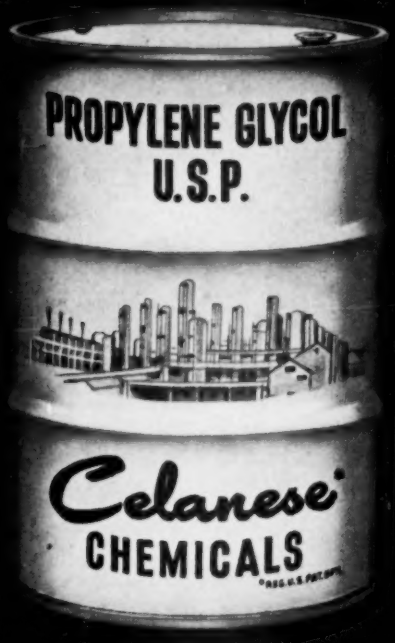

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product after it is frozen?" "Which is the best packing procedure for the product—air closure, vacuum, or gas pack?" The mobile unit has already proven itself a boon to the Continental Research Division in testing seafood on Maryland's East Shore and for tests on peas, blueberries, raspberries, blackberries, and green beans in the Syracuse area. Future plans include a trip to Wisconsin canning areas for research on cherries, lima beans and corn, and tests on the packing of frozen apples.

◆ ◆ ◆

Minute Maid Corp., producers of fresh-frozen concentrated juices, has acquired a one-third interest in Golden Citrus Juices, Inc., Fullerton, Calif., President John M. Fox has announced. The transaction involved the purchase of stock from Eadington Fruit Company and American Fruit Growers, Inc., co-owners of Golden Citrus Juices. Each will retain a one-third interest in the processing company. Since its inception in 1951, Golden Citrus has had an enviable record of dollar return to fruit growers and the company has become one of the largest single packers of frozen concentrated juice and frozen lemonade in the West. In announcing the acquisition, Mr. Fox indicated the action was taken by Minute Maid in the interest of diversifying its supply of citrus fruits and for the potential freight savings involved.

◆ ◆ ◆

The John Thompson Dorrance Building of Biology and Food Technology at the Massachusetts Institute of Technology was dedicated on June 25. The dedication address was given by Dr. Detlev W. Bronk, president of The Johns Hopkins University and of the National Academy of Sciences. The presentation was made by Mr. Oliver G. Willits, vice chairman of the Board of the Campbell Soup Company. The company was the principal donor of the new building which honors a former president of Campbell's and an M. I. T. alumnus of the class of 1895. The new building contains approximately 108,000 square feet of gross floor area.

◆ ◆ ◆

Governor Christian A. Herter, of Massachusetts, drives a golden spike to complete the rail connection at the site of American Can Company's new fibre milk container manufacturing plant in Needham. The ceremonies marked the opening of the New England Industrial Center—an 8,000,000 square feet industrial property—on which the can-making firm's plant is being erected. Looking on are, left to right, Gerald F. Blakeley, of Cabot, Cabot & Forbes, Inc., developers of the center; F. D. Tower, Boston district sales manager for Canco, and Frederic C. Dumaine, president of the New Haven Railroad. The Turner Construction Company already has begun work on the new Canco plant, which is expected to be in operation by next July.

sol'vent

A substance capable of, or used in, dissolving something

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For example, a new tonic for anemia has been developed which contains liver concentrate, rice bran concentrate, iron and ammonium citrate, peptonized iron, thyamine hydrochloride, riboflavin, niacin, and vitamin B_{12}, compounded in a highly stable Glycerine base. After testing various types of vehicles, the manufacturer reports that Glycerine provides the best stability, and also gives a better tasting product.

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New Diamond Crystal Salt with *Antioxidant* is as simple to use as common table salt. If sodium chloride is used in your processing, this new salt will fit into your operation without extra equipment or labor.

Diamond Crystal Salt with *Antioxidant* is economical, too! The extra cost involved in salting potato chips is only about 7¢ per 100 lbs. of chips! This is a small cost to minimize returned goods.

The effectiveness, ease of use and economy ... this new salt will more than justify its test in your operation. Samples are available upon request. Send for yours today!

Write to Technical Director, Diamond Crystal Salt Co., St. Clair, Michigan.

DIAMOND CRYSTAL SALT with Antioxidant

The Fleischmann Laboratories, 810 Grand Concourse, New York 51, N. Y., research and development unit of Standard Brands Inc., will move to Stamford, Connecticut, September 15, 1953. The new address will be, The Fleischmann Laboratories, Betts Ave., Stamford, Conn.

. . . the human element

Mr. Walter J. Rudy has been appointed sales representative for the Texas-Oklahoma and Western Arkansas territory of Merck & Co., Inc., manufacturing chemists of Rahway, N. J., it was announced by Mr. Frank W. Warren, manager of the General Sales Department. In this position, Mr. Rudy will be responsible for servicing Merck customers in the feed, flour, baking, and other industries. Prior to joining the company in June 1950, Mr. Rudy was employed by Allied Mills and by the USDA. He will establish his headquarters at 1305 National City Bank Bldg., Dallas, Texas.

◆ ◆ ◆

Mr. John C. Clay, assistant administrator, National Production Authority, has completed his 14-month tour of duty with that agency and is returning to National Starch Products, New York City, as assistant to the Company's executive vice president. Mr. Clay's duties with NPA included responsibility for mobilization planning, all priorities, certificates of amortization, and other activities of five NPA divisions. National Starch Products manufactures starch products, industrial adhesives, and synthetic resins.

◆ ◆ ◆

Mr. Alfred E. Leighton, 5837 Tyndall Ave., Riverdale, N. Y. 71, N. Y., sends in word that he has written "the only Text Book on Candy Making written in the English language." Published by the Manufacturing Confectioner Publishing Co., 418 N. Austin Blvd., Oak Park, Ill., and entitled, *Text Book on Candy Making*, the book reportedly describes the how, why, and wherefore of making hard candy, fondants, fudges, caramels, marshmallows, nougats, pectin and agar jellies, gums, chocolates, and chocolate confections. Included are practical exercises for making all types of candy on a small scale. According to IFT member Leighton, the book has received good reviews in this country and in Great Britain. It sells for $6.00 from the publisher.

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Mr. James H. McNamara, dean of the sales staff of Fritzsche Brothers, Inc., New York City, manufacturers of essential oils and chemical preparations, was the honored guest at a cocktail party and dinner tendered him by his firm on Wednesday, July 1, at the New York Athletic Club. The occasion was Mr. McNamara's retirement from active duty after 35 years of service with the company. Participating in the celebration were the firm's top executives headed by Mr. Frederick H. Leonhardt, chairman of the Board, and Mr. John H. Montgomery, president. Others who spoke included vice presidents Mr. H. P. Wesemann, Dr. Ernest Guenther, Mr. Fred Leonhardt, Jr., and Mr. Joseph A. Huisking.

◆ ◆ ◆

Mr. Clifford F. Evers, IFT member, has been appointed assistant to the technical services director for Ac'cent (pure monosodium glutamate), according to an announcement by Mr. J. R. T. Bishop, vice president

in charge of the Amino Products Division of International Minerals & Chemical Corp., 20 N. Wacker Drive, Chicago. Mr. Evers will assist Dr. B. F. Buchanan, technical service director, in the technical aspects of the Ac'cent program. One of the original pioneers in frozen food research, Mr. Evers is the author of numerous books and articles on the subject. Since 1950, he has been research food technologist at the University of Maryland. From 1948 to 1950 he was director of the Fish and Wildlife Technological Laboratory. From 1946 to 1948 he served as technical director of the National Assn. of Frozen Food Packers. Prior to that time he was associated with the Birdseye Division of General Foods Corp., first as a research chemist, then as asistant production manager, and finally as director of research.

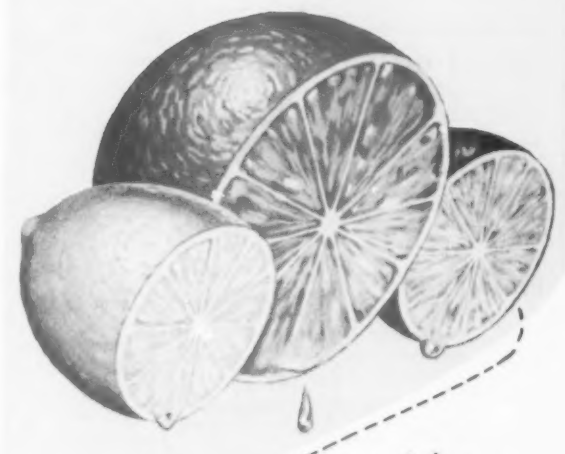
◆ ◆ ◆

Appointment of Mr. Marshal N. de Noyelles as manager and Mr. Frank Black as assistant manager of the Chemical Sales Division of Chas Pfizer & Co., Inc., was announced recently by Mr. John E. McKeen, President. Mr. de Noyelles, who has been serving as assistant manager of Chemical Sales, succeeds the late Mr. Robert H. Briggs. Mr. Black has been serving as manager of Medicinal Chemical Sales. Mr. McKeen also announced the promotion of Mr. Paul E. Weber to the post of national field sales manager. He has been western regional sales manager in the Chemical Division. Mr. de Noyelles, in one of his first official acts, appointed Mr. Malcolm K. Nielsen as western regional sales manager and Mr. George E. Mauer as industry manager of medicinal chemical sales for Pfizer.

FUTURE DATES FOR FOOD TECHNOLOGISTS

1953	
September 6-9	American Institute of Biological Sciences, University of Wisconsin, Madison
September 6-11	One hundred and twenty-fourth Meeting of the American Chemical Society, Chicago, Illinois
September 13-16	American Institute of Chemical Engineers, San Francisco, California
September 20-23	Twenty-first Annual Meeting of the Packaging Machinery Manufacturer's Institute, Skytop Lodge, Skytop, Pennsylvania.
September 21-25	National Instrument Conference and Exposition, Chicago, Illinois
October 12-14	Fifteenth Annual Forum of the Packaging Institute, New York City
October 12-14	Association of Official Agricultural Chemists, Washington, D. C.
October 19-23	National Safety Congress, Chicago, Illinois
October 19-23	Industrial Packaging & Materials Handling Exposition, Boston, Massachusetts
October 20-23	International Brewing Industries Exposition, St. Louis, Missouri
October 26-27	National Association of Suggestion Systems, Pittsburgh, Pennsylvania
October 26-27	National Pickle Packers Association, Annual Meeting, Chicago, Illinois
November 2-4	Fall Meeting of the American Oil Chemists Society, Chicago.
November 9-12	International Soft Drink Industry Exposition, Chicago, Illinois
November 11-13	Association of Food Industries Sanitarians, Berkeley, California
November 20	Dairy Industries Society, International, Washington, D. C.
June 27 to July 1, 1954	**Fourteenth Annual Meeting of the Institute of Food Technologists, Los Angeles, California**

(Information concerning future dates of national and international meetings, conventions and exhibits of interest to food technologists should be sent to the editorial office.)



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AVAILABLE: Food Technologist. B.S. in Chemistry and Biology. M.S. in Food Bacteriology and Food Technology. Two yrs. experience in food processing Quality Control as Chief Bacteriologist. REPLY BOX 289, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

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WANTED: Food Technologist. Recent graduate or with 2-3 years' experience. Nationally known food company located in Western New York. Work in quality control at start, with possible openings in plant operations. Write fully, giving complete details. REPLY BOX 294, Institute of Food Technologists, 176 W. Adams Street, Chicago 3, Ill.

POSITION WANTED: Food Technologist, M.Ch.E. Age 30. Six yrs. experience in the development and production of a wide variety of food products. Desires position in product development, production or technical service in Northeast area. REPLY BOX 293, Institute of Food Technologists, 176 W. Adams Street, Chicago 3, Ill.

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S. W. ARENSON, DIRECTOR

Proof service to the baking and potato chip industries. Ingredient evaluations. New product development. Baking, frying, spray drying equipment. Chemical and physical testing facilities.

1403 Eutaw Place Baltimore 17, Md. **440 West 24th Street New York, N. Y.**

SINCE 1870

Food Ingredient & New Drug Studies

DIGITALIS ASSAYS

Bacteriologists
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LaWall & Harrisson

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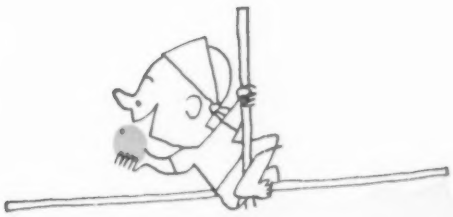
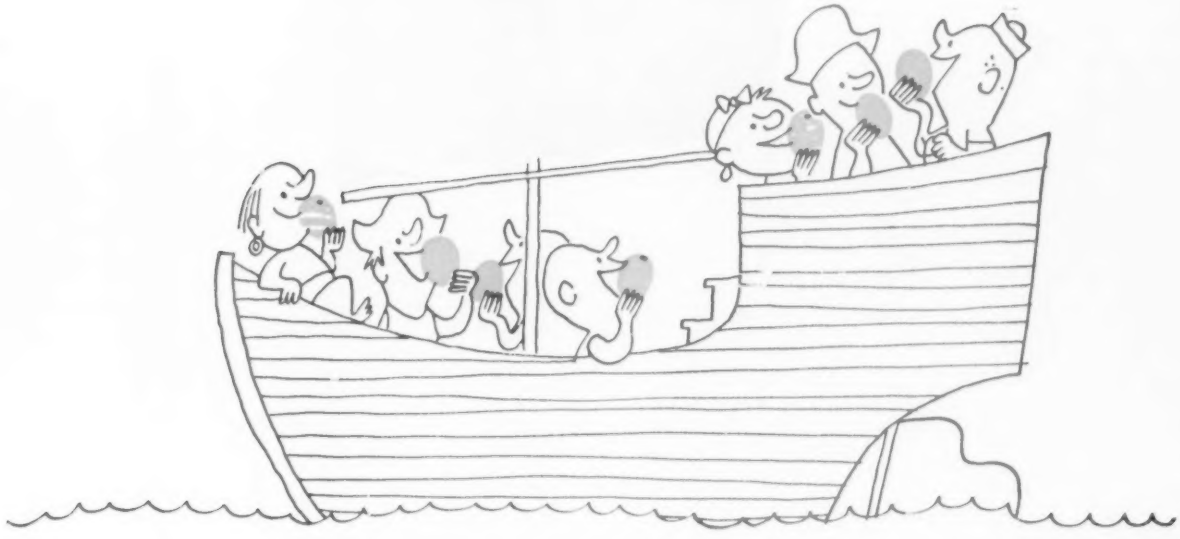
ANALYSES - CONSULTATION - RESEARCH



Peach Flavor came to the Western World
When St. Augustine was a baby;
Norda Peach builds nice, paying business:
You can prove that's a fact, not a maybe.



Norda Peach Flavor is popular.

People like it because it has the real taste of real peach. It has the true peach tart sweetness. It has the rich taste of peaches freshly picked and plump with goodness.

Both Norda Genuine and fine Imitation Peach Flavors can be most useful and profitable to you. Use them for superior results. They are concentrated; they go farther; they will cut your costs and keep up the quality that keeps building good business.

Send for samples of Norda Peach. That's the best way to convince yourself.

Use "A Favorite to Flavor It"
. . . . A Norda Flavor

Norda

ESSENTIAL OIL AND CHEMICAL COMPANY, INC.
601 West 26th Street, New York 1, N. Y.

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REMEMBER WHEN

Monosodium Glutamate

WAS A HORRID WORD?

NOT MANY YEARS AGO monosodium glutamate was the ugly duckling of the food processing industry. Its name lacked sales appeal. Just plain homely. Its reputation wasn't too well established either. The government even called it artificial flavoring and seasoning. Though food processors were becoming aware of its value in enhancing and holding natural food flavors, they were reluctant to put it on their labels. Consumers shied away. Remember? It was a horrid word. Now, only a few years later, this large Ac'cent plant at San Jose, California, has been expanded for the second time to keep up with the demand for monosodium glutamate.

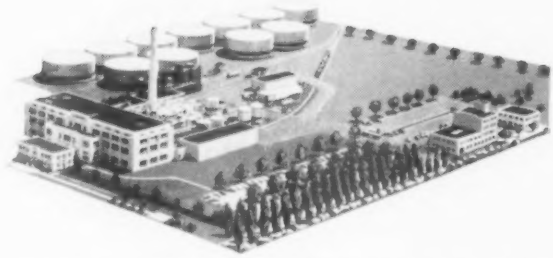
Well, what happened? What changed the buying habits of millions of housewives? What made it possible for food processors to put out better tasting products and thus win more customers, more *repeat sales?*

A few years ago, 1947 to be exact, Ac'cent launched an educational campaign. It was the first serious attempt to tell producers and consumers about the benefits and value of monosodium glutamate. It is a continuing program... the most extensive to date. It has been so successful and so effective that consumers now not only accept monosodium glutamate on labels, they *look for it!*

Like the housewives' attitude, the government view changed, too. It was influenced partly by the Ac'cent educational campaign and partly by our research work which has greatly extended knowledge of this remarkable food product.

Ac'cent has carried on research since 1946 on almost every phase of monosodium glutamate—new uses, practical application methods, uniformity of crystals. Most of the information that exists has been developed by Ac'cent, whose sole job is the making of pure monosodium glutamate. As a result, no other manufacturer of monosodium glutamate has such a vast and complete store of scientific information on the subject—much of it unpublished.

No other manufacturer of monosodium glutamate has the invaluable technical service that Ac'cent can make available to you. Our 75-man research and development staff is ready to help you immediately with specific solutions to your specific problems, even to the point of designing new machines. This service, of course, is yours for the asking—one of the extras you get with Ac'cent's always dependable crystals, the most standard and uniform in the industry.



World's Largest Plant Producing Monosodium Glutamate Exclusively. San Jose, California

Many of the leaders in the food industry already have used our facilities. In fact, a list of our customers would read like a Who's Who of the food processing industry. And an important thing to remember is that many of them are becoming leaders after consulting and working with Ac'cent technical service people.

To meet their growing needs, our customers are assured of a steady supply of monosodium glutamate—for Ac'cent, the world's largest producer of pure monosodium glutamate, has convenient warehouse stocks located in every key market. The expanded capacity of our plant at San Jose is further insurance against a possible supply shortage.

The next time you order monosodium glutamate, specify Ac'cent. You get so much more when you do.

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PURE MONOSODIUM GLUTAMATE
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